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TECOM PROJECT NO 7-ES-315-SLS-002

TEST SPONSOR: NI VISION LAB

DEVELOPMENT TEST II (SERVICE PHASE) OF NIGHT VISION SIGHT, INDIVIDUAL SERVED WEAPONS, AN/PVS-4

SECOND PARTIAL AND FINAL REPORT
BY
CAPTAIN MICHAEL D. SELVITELLE
20 NOVEMBER 1974

US ARMY
ARMOR & ENGINEER BOARD
FORT KNOX, KENTUCKY

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AMSTE-GE

15 JAN 1975

SUBJECT: Evaluation of Development Test II (Engineering and Service Phase) of Night Vision Sight, Individual Served Weapons, AN/PVS-4, TECOM Project Nos. 7-ES-315-SLS-001/002

Commander
US Army Electronics Command
Night Vision Laboratory
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1. References.

a. Final Report, Development Test II (Service Phase) of Night Vision Sight, Individual Served Weapons, AN/PVS-4, TECOM Project No. 7-ES-315-SLS-002 (US Army Infantry Board), Dec 1974. (Inclosure 1)

b. Second Partial and Final Report, Development Test II (Service Phase) of Night Vision Sight, Individual Served Weapons, AN/PVS-4, TECOM Project No. 7-ES-315-SLS-002 (US Army Armor and Engineer Board), 20 Nov 1974. (Inclosure 2)

c. Final Report, Development Test II (Air Portability/Airdrop Phase) of Night Vision Sight, Individual Served Weapons, AN/PVS-4, TECOM Project No. 7-ES-315-SLS-002 (US Army Airborne, Communications and Electronics Board), Oct 1974. (Inclosure 3)

d. Final Report, Development Test II (Engineering Phase) of Night Vision Sight, Individual Served Weapons, AN/PVS-4, TECOM Project No. 7-ES-315-SLS-001, Aug 1974.

e. Partial Report, Engineering Test of Night Vision Sight, Small Starlight Scope (Second Generation), AN/PVS-4, TECOM Project No. 7-ES-315-SLS-001, Apr 1973.

f. Partial Report, Service Test of Night Vision Sight, Small Starlight Scope (Second Generation), TECOM Project No. 7-ES-315-SLS-002 (USAIB), Feb 1973.

g. Partial Report, Service Test of Night Vision Sight, Individual Served Weapons, AN/PVS-4, TECOM Project No. 7-ES-315-SLS-002 (USAARENBD), 21 Feb 1973.

h. Approved Qualitative Materiel Requirement for Individual and Crew Served Weapons Night Vision Sights (CSCRD-64), 2 March 1964.

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SUBJECT: Evaluation of Development Test II (Engineering and Service Phase) of Night Vision Sight, Individual Served Weapons, AN/PVS-4, TECOM Project Nos. 7-ES-315-SLS-001/002

2. Approval Statement. The inclosed reports of DT II (Service Phase) and references 1d through 1g previously furnished are approved except as stated herein.

3. Background.

a. The Night Vision Sight, Individual Served Weapons, AN/PVS-4, is a passive image intensification system which uses the low-light-level illumination of the night sky (i.e., starlight, moonlight) reflected from the object and its background to form a clearly defined image. The primary components of the sight are the objective lens assembly, image intensifier tube, tube housing, and the eyepiece assembly. The objective lens assembly's primary function is to focus the light image on the photomissive cathode of the image intensifier tube. It also contains the reticle and its adjustment mechanism used in zeroing the sight to the weapon. The image intensifier tube amplifies the low-light level image and presents a highly intensified image on a phosphor screen. The eyepiece assembly magnifies the resultant image and presents it to the human eye. The eyepiece assembly also contains the necessary adjustments for focusing the sight at various ranges and for correcting the sight picture for the individual variances in the human eye of the various users. The tube housing contains the wiring and housing for the battery-operated power supply. With the exception of the objective lens assembly, all components of the AN/PVS-4 are identical to the components of the Night Vision Sight, Crew Served Weapons, AN/TVS-5.

b. The DT II (Engineering Phase) was initiated on 27 July 1972 at the US Army Aberdeen Proving Ground; DT II (Service Phase) was initiated at the US Army Infantry Board on 26 September 1972; and at the US Army Armor and Engineer Board on 19 October 1972. On 5 January 1973, TECOM suspended testing due to extremely low reliability experienced in the image intensifier tubes. Test agencies were requested to submit partial reports so that TECOM could evaluate whether the tests should be terminated (references 1e through 1g). As a result of the review of the partial reports, 10 equipment deficiencies, 1 maintenance package deficiency, and 17 equipment shortcomings were assessed against the AN/TVS-5 and AN/PVS-4 sights. On 15 March 1973, a meeting was held with representatives of the Night Vision Laboratory to discuss the problems being experienced. As a result of this meeting, it was decided to keep the test in suspension until NVL provided modified test items for DT II (Engineering Phase). Sufficient testing would be conducted at USAAPG to assure that reported deficiencies had been corrected before DT II (Service Phase) would be reinitiated.

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c. The DT II (Engineering Phase) was reinitiated at USAAPG on 1 August 1973 and completed on 7 June 1974. The DT II (Service Phase) was reinitiated at the USAIB on 13 May 1974; at the USAARENBD on 30 April 1974; and at the US Army Airborne, Communications and Electronics Board on 25 April 1974. Testing at the USAACEBD was completed on 17 September 1974; at the USAARENBD on 12 August 1974; and at the USAIB on 1 November 1974.

d. All testing was performed in accordance with the approved test plans which were coordinated with USACDC, USAECOM, and USALEA.

4. Test Results.

a. Overall Evaluation.

(1) Of the seven performance characteristics of the QMR, reference 1h, the AN/PVS-4 meets four, partially meets one, and fails to meet two of the requirements. While the item fails to meet the magnification requirement of 4, the actual magnification of 3 is considered to be satisfactory as observers are able to recognize a high percentage of standing man targets from 25 to 400 meters in clear air and starlight and from 25 to 600 meters in clear air and moonlight. The desired requirement for the AN/PVS-4 to be capable of seeing through enemy camouflage is not met. Environmental engineering tests indicate that the sight should perform satisfactorily in all climatic categories of AR 70-38 except category 8, extreme cold.

(2) Of 16 essential physical characteristics of the QMR, 11 are met, two are partially met and three are not met. While the length requirement of 11 inches is not met, the actual length of 11.7 inches is considered to be satisfactory. Although the sight fails to meet the fungus requirement of the QMR due to fungus forming on the web strap of the carrying case and eyepiece of the sight during engineering tests, this failure should not have a serious effect on the performance of the sight. While the image intensifier tubes meet the sensor life requirements of the QMR of at least 1,000 hours, the AN/PVS-4 fails to meet the mean-time-between-failure requirement of the QMR of 1,000 operating hours (see paragraph 4g below). Mounting brackets provided are satisfactory with the exception of the deficiency cited in paragraph 4b(2) below and the shortcomings cited in paragraphs 3 through 5 of Inclosure 4. Reticle patterns provided are satisfactory except for the shortcomings cited in paragraphs 1, 2 and 11 of Inclosure 4. Even though the deficiency and shortcomings exist, the AN/PVS-4 provides an effective night sighting device for all weapons with which it is intended to be used, except the M16A1/M203 weapon system.

(3) The sight meets all maintenance and human engineering characteristic requirements of the QMR. However, changes are necessary in the maintenance test package to make it acceptable.

(4) Performance of the AN/PVS-4 is equal to or exceeds that of the AN/PVS-2B (product-improved 1st generation) except in the area of reliability. However, the reliability of the AN/PVS-4 is higher than that demonstrated by the AN/PVS-2 during the same stage of development (i.e., during ET/ST). The AN/PVS-4 was preferred over the AN/PVS-2B by the majority of the users when used either in the hand-held mode for tactical observation or as a weapon sight.

b. Deficiencies (5).

(1) The maintenance test package is inadequate for the following reasons:

(a) The technical manuals contain incorrect, incomplete and unclear instructions (Paragraphs 1.3.1 and 2.2, Appendix C, Inclosure 2, and Paragraph 2.7, Inclosure 1).

(b) The proper MOS for performance of organizational maintenance in Armor units is not designated (Paragraph 1.3.2, Appendix C, Inclosure 2).

(2) The range indicators of the M16/M203 combination weapon are not correlated in the aiming system. The M203 adapter bracket range scale is not properly calibrated with the grenade aiming point on the M16A1 reticle. If the sight is zeroed to the M203 grenade launcher the reticle does not provide an accurate aiming point for the M16A1 rifle and vice versa. Deficiency paragraph 1.1 and Shortcoming 2.4 of Appendix C, Inclosure 1 and Shortcoming paragraph 2.8, Appendix C, Reference 1d have been combined into this single deficiency.

(3) The three following equipment deficiencies are considered to be the major contributors to the failures which resulted in the reliability and durability deficiency being assessed against the sight by the USAIB in paragraph 2.9.5.5 of Inclosure 1.

(a) The method of bonding the eyeguard to the eyeguard retaining ring is inadequate. When the eyeguard separates from the retaining ring the sight cannot be used either for weapon firing, since the operator no longer has eye protection from weapon recoil, or for tactical observation, as security from detection is lost. Deficiency paragraph 1.2, Appendix C, Inclosure 1 and Paragraph 1.1, Appendix C, Reference 2 have been combined into this single deficiency.

(b) The method employed in wiring the image intensifier tube to the housing is inadequate. As a result, the fine wires used are easily damaged during assembly, maintenance, or use causing failures of the sight. Shortcoming 2.18, Appendix C, Reference 1d has been reclassified to this deficiency.

(c) The epoxy compound used in manufacturing of the image intensifier tube does not adequately moisture proof the tube. Moisture enters the multiplier causing the tube to shut off. This is an added deficiency resulting from NVL's analysis of image tube failures.

c. Shortcomings (11). See Inclosure 4

d. Declassifications (9).

(1) Paragraph 2.8, Appendix C, of Inclosure 1 reports as a shortcoming that the sight does not permit rapid and positive identification of defective or malfunctioning components. The maintenance charts indicate that the maximum time to diagnose the cause of any of the 18 failures is 0.2 hours. This maximum diagnostic time of 12 minutes, which includes time to disassemble the sight, is considered to have met the requirement for which there is no specified time. This shortcoming is declassified and is reported for information only.

(2) Paragraph 2.3, Appendix C of Inclosure 2 reports as a shortcoming that the design of the locking knob for the mounting bracket is such that it cannot be secured to the bracket; thus, it falls out of the bracket. Paragraph 2.8.5.7, Inclosure 2 indicates that this did not occur during 2,072.5 hours of testing and that periodic knob tightening by the operator will keep the sight firmly affixed to the bracket. This shortcoming is declassified and is reported for information only.

(3) Paragraph 2.1, Appendix C of Reference 1d reports as a shortcoming that storage containers are not supplied for the weapon-adapter brackets M60, M79, M67, M72A1 and M16 with M203. The agencies conducting the DT II (Service Phase) had no problem storing or transporting these brackets when not attached to the weapon and did not consider the absence of a storage container to be a shortcoming. The shortcoming is declassified and is presented for information only.

(4) Paragraph 2.2, Appendix C of Reference 1d reported as a shortcoming that the angular resolution of 1.3 lp/mr at 10^{-3} foot-candles is inadequate for night viewing. However, users were able to recognize a high percentage of standing man targets at ranges of 25 to 400 meters in clear air under starlight conditions and 25 to 600 meters in clear air under moonlight conditions as required by the QMR. The shortcoming is declassified and is presented for information only.

(5) Paragraph 2.6, Appendix C of Reference 1d reported as a shortcoming that the M72 adapter bracket interfered with the action of the arm-safe pull lever. The brackets for the M72 were modified by NVL prior to being furnished for DT II (Service Phase). This problem was not experienced during the DT II (Service Phase) and, therefore, this shortcoming is considered a corrected shortcoming and is declassified and presented for information only.

(6) Paragraph 2.10, Appendix C of Reference 1d reports as a shortcoming that the shipping case liners are not pliable and prevent repacking of the sight in the case at all temperatures below -25°F. The NVL has redesigned the interior openings of the case to provide sufficient clearances. The shortcoming is declassified and is presented for information only.

(7) Paragraph 2.13, Appendix C of Reference 1d reports as a shortcoming that the eyeguard ring freezes to the sight at -25°F and prevents access to the demist lens. Due to its high cost and limited usefulness, the demist lens has been eliminated and this is no longer a problem. The shortcoming is declassified and is presented for information only.

(8) Paragraph 2.14, Appendix C of Reference 1d reports as a shortcoming that the variable diopter ring freezes to the sight at -65°F and prevents lens adjustment of the sight to the eye characteristics of the operator. The sight will be stored in areas where temperatures are well above -65°F and the user will normally adjust the diopter setting upon being issued the sight. This shortcoming is declassified and is presented for information only.

(9) Paragraph 2.17, Appendix C of Reference 1d reports as a shortcoming that the weapon-adapter brackets are susceptible to humidity damage. During humidity tests some of the screws, wing nuts, and washers used on various brackets rusted. This rusting can be prevented by application of oil and proper maintenance. This shortcoming is declassified and is presented for information only.

e. Safety. Other than the safety problems associated with the deficiency, paragraph 4b(3)(a) and the shortcoming, paragraph 7, Inclosure 4, there are no safety problems associated with use or maintenance of the sight.

f. Maintenance/Maintainability. The design for maintainability of the sight is adequate except for the method of wiring the image intensifier tube to the housing (Deficiency paragraph 4b(3)(b) above). Combining maintenance data from the USAIB, USAARENBD, and USAAPG, the AN/PVS-4 demonstrated a Maintenance Ratio (MR) of 0.0024 and an Achieved Availability (Aa) of 0.9976. The maintenance test package is inadequate (Deficiency 4b(1) above).

g. Reliability.

(1) Test Criteria from the QMR, reference 1h, are as follows:

(a) Normal combat life of this item (mean-time-between-failure not including operator maintenance requirements) will be 1,000 operating hours, 2,000 operating hours (desirable).

(b) Sensor life will be at least 1,000 hours, 2,000 hours (desirable).

(2) AN/PVS-4

(a) During DT II testing of the AN/PVS-4 at the USAAPG, USAARENBD, and the USAIB there was a total of 13,721 hours of sight operation with 22 chargeable system failures occurring. Based on an exponential failure distribution, the point estimate of MTBF was 624 hours. The two-sided 80 percent confidence-interval estimate provides an upper-limit MTBF of no higher than 845 hours and a lower-limit MTBF of at least 468 hours.

(b) Of the 22 chargeable system failures, the 5 eyeguard, 2 broken wires and 4 of the image intensifier tube failures, due to the moisture entering the tube as a result of improper potting material being used, are associated with the deficiencies cited in paragraphs 4b(3)(a), 4b(3)(b) and 4b(3)(c) above. The Night Vision Laboratory has instituted changes in the manufacturing techniques of the image intensifier tubes. This should eliminate 2 failures due to insufficient scrubbing of the microchannel plate and 2 failures due to gas leaks in the image intensifier tubes which caused shorts. Assuming that modifications made to correct the deficiencies and manufacturing techniques of the image intensifier tubes are successful, the point estimate of MTBF based on 13,720 hours of sight operation and the 7 remaining uncorrected failures is 1,960 hours.

(3) Image Intensifier Tubes

(a) During testing of the AN/TVS-5 and AN/PVS-4 at the USAAPG, USAARENBD, and the USAIB a total of 42 tubes were subjected to 20,992 hours of testing with 14 failures occurring. An analysis was conducted to determine the failure distribution of the image intensifier tubes. The distribution of failure times was determined to be Weibull from Nelson's method of Hazard Plotting for Incomplete Failure Data. Using graphical methods, it is estimated that of the tubes under test, 54 percent would have failed before 1,000 hours and that the mean life of the tubes under test is estimated to be 1,472 hours.

(b) Of the 14 tube failures, 11 were associated with the same types of failures discussed in paragraph 4g(2)(b) above. Assuming correction of these failures, the point estimate of MTBF for the image intensifier tubes based on 20,992 hours of operation and 3 failures should be 6,997 hours. This is not to predict that tube life will be as high as the MTBF.

5. Comments.

a. With regard to the deficiency, paragraph 4b(3)(a) above, the NVL provided modified eyeguards to the USAIB for evaluation during testing of the AN/TVS-5. While the modification was not considered to be completely adequate, it did prevent the sudden loss of an eyeguard from making the sight unusable. The modification, together with periodic inspection of eyeguards and replacement of those which are damaged to the point where they might be lost, will eliminate this deficiency. The manuals should be modified to indicate that the monthly preventive maintenance check include inspection of the eyeguard and replacement if necessary.

b. With regard to the deficiency, paragraph 4b(3)(b) above, all 1st generation night vision sight tubes are constructed so that power supply and grounding connections to the housing are made through pin/socket connections. This type of connection has proven to be completely satisfactory during all testing conducted by TECOM. Modification of the image intensifier tube wiring system to pin/socket type connections should eliminate the failures.

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c. DT II (Environmental Phase) is scheduled for conduct during 2d and 3d Quarter FY 75 and 1st Quarter FY 76. Modifications required to correct deficiencies and shortcomings should be made to the equipment prior to test items being furnished for testing. This will permit testing of modifications to determine adequacy prior to full-scale production.

6. Conclusions.

a, The operational capabilities of the Night Vision Sight, Individual Served Weapons, AN/PVS-4 equal or exceed those of the Night Vision Sight, Individual Served Weapons, AN/PVS-2B.

b. Correction of the deficiencies and shortcomings should increase the reliability of the AN/PVS-4 to the QMR requirements.

7. Recommendation. The deficiencies and as many as feasible of the shortcomings be corrected and verified by TECOM during DT II (Environmental Phase) and DT III of the Night Vision Sight, Individual Served Weapons, AN/PVS-4.

FOR THE COMMANDER:

for WILLIAM H. TUCKER, JR.
Colonel, GS
Deputy to the CG for Testing

WILLIAM H. YOUNG
COLONEL, GS
DIRECTOR, TEST OPERATIONS

4 Incls
1. USAIB Final Report - 7-ES-315-SLS-002
2. USAARENBD Second Part & Final Report - 7-ES-315-SLS-002
3. USAACEBD Final Report - 7-ES-315-SLS-002
4. Shortcomings

SHORTCOMINGS

1. The reticle pattern for the M16A1, M14, and M60 weapons requires the user to estimate ranges except at 400 and 600 meters. At ranges less than 400 meters the user is confused as to where on the pattern to sight, which reduces hit probability. Shortcomings 2.3, Appendix C, Reference 1d and 2.6, Appendix C, Inclosure 1 have been combined into this single shortcoming.

2. All reticle patterns provided are not plumb and cannot be adjusted by the operator. This results in inaccuracy of the weapon/sight combination at all ranges other than the range at which the weapon/sight has been zeroed (Paragraph 2.5.5, Reference 1d).

3. The range marks on the M79 launcher adapter bracket are inaccurate for some ranges. This reduces the hit probability at ranges other than the range at which the weapon/sight combination is zeroed (Paragraph 2.5.5, Reference 1d).

4. The M72 launcher bracket/reticle combination does not properly compensate for temperature effect on the M72 missile. This results in a lower firing accuracy when temperatures change significantly between the time the weapon/sight combination is zeroed and the time when the sight is used to fire the weapon (Paragraph 2.5.5, Reference 1d).

5. The M60 machine gun bracket does not maintain sight zero and is difficult to mount. As a result of cross-country travel with the sight mounted on the M60 machine gun on the M114 vehicle, mounting and remounting operations on the M60 machine gun used by Infantry squads, or as a result of weapons firing, there is a shift in zero of the sight resulting in decrease in hit probability. Shortcomings reported in Paragraph 2.5.5, Reference 1d; Paragraphs 2.6.5.1a and 2.11.5.5b, Inclosure 1; and the deficiency reported in Paragraph 2.4.5.3, Inclosure 2 have been combined into this single shortcoming.

6. The material used in the carrying case loses it pliability at temperatures below -25°F (Paragraph 2.7.5, Reference 1d). In climatic areas where temperatures occur below -25°F, the carrying case freezes. If this occurs when the carrying case is in a collapsed condition, it cannot be used to carry the sight.

7. The eyeguard material freezes at -65°F (Paragraph 2.7.5, Reference 1d). In the frozen condition, the eyeguard loses weapon-recoil protection.

8. The insulation of the low-temperature adapter cable cracks and loses its insulative properties during use at -65°F (Paragraph 2.7.5, Reference 1d). This could result in loss of power to the sight.

9. The eyeguard and carrying case straps are not adequately treated for fungus resistance (Paragraph 2.11.5, Reference 1d). During fungus test there was fungus growth on the eyeguard and web straps of the carrying case.

10. The daylight cover does not provide sufficient variations of openings to permit zeroing of the weapon/sight combination during all light conditions. As a result, either the reticle pattern or the target is difficult to see in bright daylight, bright moonlight, heavy overcast daylight or at dawn and dusk, which prevents zeroing operations. Shortcomings Paragraphs 2.6.5.2d, Inclosure 1 and 2.4.5.4, Inclosure 2 have been combined into this single shortcoming.

11. The one reticle provided for use when the sight is mounted on the M16A1, M14, M60 and M79, and M203 brackets is confusing to the user. The reticle picture contains so much information that the user is easily confused as to what sighting point he should use with which weapon thus reducing hit probability (Paragraph 2.6.5.2b, Inclosure 1)

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17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

See Item 16.

18. SUPPLEMENTARY NOTES

None

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Night Vision Sight, Individual Served Weapons
AN/PVS-Four (Second Generation Sight)
AN/PVS-Two B, First Generation Sight (Control)
Objective Lens Assembly
Image Intensifier Tube
Battery-operated Power Supply

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Test objectives were to determine to what degree the test item meets the performance requirements of the QMR, and to evaluate the adequacy of the maintenance package. This report includes results and analysis of data collected from 30 April 1974 through 12 August 1974, and a review of the first partial report to provide a complete evaluation of the test item during the conduct of the test. Throughout testing, the first generation sight, AN/PVS-2B was used

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as a control sight. From the time testing was reinstated to test completion, the two test items had accumulated 2,072.5 hours; were transported a total of 693.5 miles; and had been subjected to the shock and vibration effects of 18,000 rounds of M60 7.62MM ammunition. Three of the 28 requirements listed in app B were deleted in the first partial report. The remaining 25 requirements entailed evaluation of 23 essential criteria and four desirable criteria. Seventeen of 23 essential criteria were met. Four essential criteria were not met (one pertained to obtaining a hit probability at night equal to that obtained in daylight; one to durability; one to dustproof qualities; and one to adjustment of sight by operators wearing gloves). Two essential criteria pertaining to MTBF and sensor life were not assessed. One of the four desirable criteria was met; one pertaining to capability of seeing through camouflage was not met. Two desirable criteria pertaining to MTBF and sensor life were not assessed. The test item was deficient in the areas of alignment and zero, and maintenance evaluation (equipment publications and MOS requirements). One chargeable failure was experienced during the 2,072.5 hours of testing since test reinitiation. The US Army Armor and Engineer Board concluded that: The Night Vision Sight, Individual Served Weapons, AN/PVS-4, as tested does not maintain its adjusted zero after cross-country travel; lacks a satisfactory eyeguard bonding design, and has an inadequate maintenance test package (equipment publications and MOS requirements); the Night Vision Sight, Individual Served Weapons, AN/PVS-4 as tested is superior in overall performance to the AN/PVS-2B control sight. The US Army Armor and Engineer Board recommended that: the deficiencies and shortcomings (if feasible) listed in app C be corrected; the modified test item be retested; and the revised equipment publications be evaluated.

SUMMARY

RESULTS

a. Three of the 28 requirements listed in app B were deleted in the first partial report. The remaining 25 requirements entailed evaluation of 23 essential criteria and four desirable criteria. Seventeen of the 23 essential criteria were met. Four essential criteria were not met (one pertained to obtaining a hit probability at night equal to that obtained in daylight; one to durability; one to dustproof qualities; and one to adjustment of sight by operators wearing gloves). Two essential criteria pertaining to MTBF and sensor life were not determined. One of the four desirable criteria was met; one pertaining to capability of seeing through camouflage was not met. Two desirable criteria pertaining to MTBF and sensor life were not assessed.

b. The test item was satisfactory in the areas of preoperational inspection (para 2.1); stowage (para 2.2); safety evaluation (para 2.3); target detection, recognition, and identification (para 2.5); hitting performance (para 2.6); observation and security (para 2.7); and human factors engineering (para 2.10). (Reliability and durability were not assessed (para 2.8).)

c. The test item was unsatisfactory in the area of alignment and zero (para 2.4); and maintenance evaluation (maintenance test package) (para 2.9).

d. Three deficiencies were assessed at the end of testing: one to the inability to maintain adjusted zero after cross-country travel; one to rubber eye guard separation; and one to inadequate maintenance test package (equipment publications and MOS requirements). (See para 1, app C.)

e. Three shortcomings were assessed against the test item: one pertained to reliability/durability, and two to alignment and zero. (See para 2, app C.)

f. One chargeable failure was experienced during the 2,072.5 hours of testing since test reinitiation in April 1974. No failures were experienced with the image intensifier tubes.

g. The test item was considered safe to operate and maintain.

DISCUSSION

Test results on the AN/PVS-4 are a composite of findings from two testing periods with the test item at the USAARENBD. Test results have indicated two deficient areas with the test item. These deficiencies,

however, should be viewed relative to the overall performance of the test and control sights. During the final test phase, the test sight demonstrated better performance for detecting and engaging targets than did the control sight during both normal and adverse weather conditions. The crewmembers (and project officer and NCO), who were interviewed informally during the conduct of the test, felt that the test sight performed better overall, was easier to use, and was preferred over the control scope for detection and recognition at all ranges. Through informal collective interviews with the test crews, the expressed general opinion was that notwithstanding the eye guards and alignment problems, the AN/PVS-4 test sight was far superior to the AN/PVS-2B control sight.

CONCLUSIONS

The US Army Armor and Engineer Board concludes that:

a. The Night Vision Sight, Individual Served Weapons, AN/PVS-4 as tested is superior in overall performance to the AN/PVS-2B control sight.

b. The Night Vision Sight, Individual Served Weapons, AN/PVS-4, as tested does not maintain its adjusted zero after cross-country travel; lacks a satisfactory eyeguard bonding design, and has an inadequate maintenance test package (equipment publications and MOS requirements).

RECOMMENDATIONS

The US Army Armor and Engineer Board recommends that:

a. The deficiencies and shortcomings (if feasible) listed in app C be corrected.

b. The modified test item be retested and the revised equipment publications be evaluated.

FOREWORD

The Armor Test Branch of the US Army Armor and Engineer Board was responsible for test planning, test execution, and test reporting. The maintenance evaluation portion of the report was prepared by the Maintenance Evaluation Branch of the board.

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SECTION 3. APPENDIXES

SECTION 1. INTRODUCTION

1.1 BACKGROUND

1.1.1

In 1964, a requirement was approved for a night vision weapons sight to replace the then standard active infrared weapons sight. The sight was to be passive in nature to minimize detection by the enemy. In addition to its use as a weapons sight, it was intended that the sight be used as a hand-held night observation and surveillance device. The requirement stated that the sight was to be capable of recognizing standing personnel (target detection) at a range of 400 meters in clear air and starlight, and 600 meters in clear air and moonlight. As a weapon sight, it was to provide a night fire capability close to that of daylight.

1.1.2

To meet this requirement, the US Army Materiel Command Project Manager, Night Vision, developed a first generation sight which represented the best that could be done within the state-of-the-art and with the components available at the time. A service test of this sight was conducted in 1964 by the US Army Infantry Board. As a result of this test and the engineering test, the US Army Test and Evaluation Command concluded that the Weapon Sight, Night Vision (Individual):

1.1.2.1 Failed to meet all the qualitative materiel requirements prescribed for its development.

1.1.2.2 Offered significant improvement over the weapon sight, infrared, in all cases except those where the ambient light level had been reduced appreciably by an overhead foliage canopy or heavy overcast condition.

1.1.2.3 Contained brackets and components significantly more versatile than the weapon sight, infrared, and its associate sight brackets and components.

1.1.2.4 Was less reliable at low temperatures.

1.1.2.5 Provided insufficient eye protection during weapon recoil.

1.1.2.6 Has an application in armor as a sight for the M60 machinegun, the cupola-mounted M85 machinegun, and as a hand-held, night vision device.

1.1.2.7 Required a means to mount the test sight on the M60 series tank cupola for use with the M85 machinegun.

1.1.2.8 Required correction of deficiencies in order to be suitable for Army use.

1.1.2.9 However, due to the generally improved performance of the starlight scope over the infrared weapon sight and to urgent requirements for a night vision sight, the starlight scope was type classified as Standard A in 1965. Following service tests, various improvements were made in the starlight scope and the USAIB conducted a confirmatory test of the production model in 1967. The sight was designated the AN/PVS-1 in 1967. Additional improvements were made in the AN/PVS-1, and in 1969, the improved version was designated AN/PVS-2 and was type classified as Standard A; the type classification of the AN/PVS-1 being changed to Standard B. These scopes have been referred to as the First Generation Starlight Scopes. (See photo, page A-2, app A.)

1.1.3

The Project Manager, Night Vision, developed a second generation device designed to meet the requirements not met by the first generation types. TECOM directed that USAIB, as executive test agency, plan and conduct the service test of the second generation devices for infantry use, with certain phases to be conducted by the US Army Armor and Engineer Board and the US Army Airborne, Communications and Electronics Board. For the Armor application phase two test items were received, and testing was initiated by USAARENBD on 19 October 1972. The test was scheduled to run until February 1973, but was suspended by TECOM on 8 January 1973 because of reliability difficulties experienced by the Infantry Board during firing exercises (ref 1, app F). Results of that testing are contained in ref 2, app F, hereinafter referred to as the first partial report. The problems uncovered were addressed by Night Vision Laboratory and the results from limited range firing were encouraging. Two new test items were delivered to the USAARENBD and testing was reinitiated on 30 April 1974.

1.1.4

To gather input for an IPR scheduled in September 1974, TECOM directed USAARENBD to submit a letter report by 8 July 1974. The letter report, with maintenance indices and risk assessment which was submitted covered the test results for the period of 30 Apr 74 to 17 Jun 74. After this report was submitted, evaluation of the test items continued.

1.1.5

The authority for conducting this test is the test directive (ref 4, app F) as amended (ref 5, app F).

1.2 DESCRIPTION OF MATERIEL

1.2.1

The Night Vision Sight, Individual Served Weapons, AN/PVS-4, hereinafter referred to as the test item or test sight, amplifies the low light level illumination of the night sky (i.e., starlight, moonlight) reflected from the object and its background to form an erect, clearly defined image. The primary component of the sight is the image intensifier tube. The tube operation is such that a light image focused on a photo-emissive cathode by an objective lens causes the emission of electrons in direct proportion to the light energy falling on each unit area of the cathode. The electrons are accelerated and focused by the high-voltage electron optical system and travel through the microchannel plate, which multiplies the electrons and impinge on a phosphor screen providing a highly intensified image of the initial low-light-level image falling on the cathode. The eyepiece magnifies the resultant image and presents it to the human eye. High voltage for the tube is provided by a battery-operated power supply. (See photo, page A-3, app A.)

1.2.2

The following modifications/corrections were made on the test item by Night Vision Laboratory prior to reinitiation of testing on 30 April 1974:

1.2.2.1 Objective Lens

a. Installed ground wire from housing to reticle diode socket

b. New housing casting

c. New azimuth and elevation mechanisms

d. Refocused reticle optics (so image fell on cathode)

e. Reset reticle pattern spacing and alignment

f. New reticle cell material (nylon instead of noryl)

g. New daylight cover.

1.2.2.2 Main Housing

a. Coarse threads on battery compartment (instead of fine thread)

b. New battery caps and O-rings

c. Coarse, double-strand thread on range focus (instead of fine thread)

d. New reticle spring contact pin

e. A 750-ohm resistor on reticle brightness control (to cut down reticle brightness).

1.2.2.3 Eyepiece

a. New focus ring

b. New lens stop lockring

c. All eyepiece cells set to the same tube screen clearance

d. Rubber eyeguard recemented

e. Eyeguard slipring material changed to aluminum

f. Eyeguard setscrews changed to stainless steel

g. Removed demist shield.

1.2.2.4 Image Intensifier Tube

a. Different tube manufacturer

b. Increased cone and decelerator spot welds

c. Changed "potting" techniques

d. More "scrubbing" of microchannel plates

e. Tube screen made flush with the tube boot to $\pm$ .005 tolerance.

1.2.2.5 Draft technical manuals were revised.

1.3 TEST OBJECTIVES

1.3.1

Determine to what degree the test item meets the performance requirements of the QMR.

1.3.2

Evaluate the adequacy of the maintenance package.

1.4 SCOPE

1.4.1

Two Night Vision Sights, Individual Served Weapons, AN/PVS-4, Serial Numbers 95-112 and 95-113, were tested by the US Army Armor and Engineer Board under field conditions in a simulated military user environment beginning on 30 April 1974. Data gathering was completed on 8 August 1974. Temperatures ranged from 43° Fahrenheit to 91° Fahrenheit during the cited test period. From the time testing was reinitiated to test completion, the two test items accumulated a total of 2,072.5 hours, were transported a total of 693.5 miles, and had been subjected to the shock and vibration effects of 18,000 rounds of M60 7.62MM ammunition. Testing was conducted utilizing the approved Plan of Test (ref 6, app F).

1.4.2

Previous testing during the period 19 October 1972 to 8 January 1973 evaluated preoperational inspection; stowage; safety evaluation; target detection, recognition and identification; observation and security; and human factors engineering. When reliability problems were encountered by USAIB, testing was suspended and results were reported in the first partial report (ref 2, app F).

1.4.2.1 When testing was reinitiated on 30 April 1974, the concept was to complete the earlier subtests and to reevaluate any subtests affected by the modifications mentioned in para 1.2.2 of this report. While the latter formulation was aimed primarily at the reliability and durability, and maintenance evaluation subtests, any discrepancies with completed results in other areas were noted. The test sights were subjected to the following subtests: alignment and zero; hitting performance; reliability and durability; safety evaluation; human factors engineering; and maintenance evaluation. (Maintenance evaluation was limited to evaluation of maintenance required to keep the test sights operational, and an evaluation of the maintenance test package.) On 8 July 1974, an interim report was submitted reflecting the status of the above subtests to 17 June 1974 (ref 3, app F). At that time, none of the cited subtests were completed. Testing continued and was completed on the above subtests on 12 August 1974.

1.4.2.2 The first partial report contains results and analysis of the testing conducted during the first phase of the test. The results and analysis of individual subtests in this report (second partial and final) are concerned with testing conducted during the second phase

of testing, from the time testing was reinitiated on 30 Apr 74 to test completion on 12 Aug 74. Brief summaries of earlier significant results and system faults are contained in the subtests of this report, but more detailed analysis can be obtained by referring to the first partial report. App B, Test Findings, and App C, Deficiencies and Shortcomings, reflect the findings of both reports.

1.4.2.3 Throughout all testing, the First Generation Night Vision Sight, Individual Served Weapons, AN/PVS-2 served as a control sight. Initial testing was with the A series first generation sight. However, the tubes in the two sights were replaced with automatic brightness control tubes transforming the sights into AN/PVS-2B's. All subtests were conducted using both the test and control sight. The use of a comparison sight allowed direct comparison of results obtained during testing at this board and obviates the necessity for comparing the results obtained in current testing with the results obtained in prior testing.

1.4.3

To evaluate the effectiveness of the modifications on the reliability and durability subtest, the two test sights were operated the maximum number of hours possible on an M114A1 command and reconnaissance carrier under field operating conditions and under surveillance in the shop area. An adequate amount of time was allotted to establish the required MTBF with a point estimate. The total number of sight and tube failures were one and zero respectively, and a point estimate of MTBF was not made.

1.4.4

The (second generation) Night Vision Sight, Individual Served Weapons, AN/PVS-4, was evaluated against the test criteria contained in app B and compared with results obtained with the control sight.

1.4.5

Throughout the test, test personnel were instructed in and followed all safety precautions in the safety release, draft equipment publications, and other appropriate documents.

1.4.6

For the purpose of clarification of terms, the following definitions are provided.

1.4.6.1 Detection. Identification of the presence of a target of potential military interest in a reasonable time, but without recognition of the object.

1.4.6.2 Recognition. Discrimination between targets (objects) as to class, e.g., tank, truck, man.

1.4.6.3 Identification. Discrimination between targets (objects) within a class, e.g., M60 tank, M113 APC.

1.4.6.4 Moonlight Band. Illumination on the order of 4×10^{-2} to 7×10^{-4} foot lamberts.

1.4.6.5 Starlight Band. Illumination on the order of 7×10^{-4} to 7×10^{-5} foot lamberts.

1.4.6.6 Overcast Band. Illumination on the order of 7×10^{-5} to 1×10^{-5} foot lamberts.

1.4.6.7 Clear Air. Condition which exists during unlimited visibility, i.e., no ground fog, haze, or clouds.

SECTION 2. DETAILS OF TEST

2.1 PREOPERATIONAL INSPECTION

Complete results and analysis of this subtest are included in the (first) partial report, ref 2, app F. In the cited report, a shortcoming was assessed against the test item because of improper size demist lenses. As a result of modifications, the lens were subsequently deleted from the test item. (See para 3.1, app C.) The criterion in this subtest was met. (See item 28, app B.)

2.2 STOWAGE

Results and analysis of this subtest are included in the first partial report, ref 2, app F. Stowage mileage is discussed in this report in para 2.8.4.2 and 2.8.5.1. The criterion in this subtest was met. (See item 5, app B.)

2.3 SAFETY EVALUATION

2.3.1 Objective

To determine if the test item is safe to operate and maintain in its intended role.

2.3.2 Criteria

2.3.2.1 The test item shall be safe to operate and maintain (USAARENBD).

2.3.2.2 Flash and glare protection for the operator . . . is essential. . . (QMR, para 8g).

2.3.3 Method

2.3.3.1 Prior to starting test operations, the test items were inspected for actual or potential safety hazards. Special attention was given to safety hazards and operational restrictions described in the safety release, maintenance publications, and on warning plates. Complete reliance was not placed on procedures prescribed in Preliminary Operating and Maintenance Manuals or Technical Manuals unless they had been critically reviewed and found to provide the safety procedures for the particular test operation.

2.3.3.2 The operator/crew and supervisory personnel watched for and recorded actual or potential safety hazards during initial and all subsequent inspections, servicing, and maintenance of test items, and all functional testing. Maintenance personnel were instructed to record any actual or potential safety hazards revealed during maintenance of the test item.

2.3.3.3 The operator/crew were instructed to report any headaches, or dizziness experienced when using the test item.

2.3.3.4 Throughout all firing exercises, operating personnel were instructed to report any difficulties in performing the firing mission resulting from flash and glare of the weapons.

2.3.4 Results

2.3.4.1 As noted in the first partial report, no actual or potential safety hazards were discovered during the course of the test. No complaints of headaches or dizziness were received from the operators when they were using either the test or control item. This continued to be the case during the final phase of testing.

2.3.4.2 No flash or glare problems were encountered during extensive firing exercises conducted with the M60 machinegun. "Blooming" or "whiteout" was a problem when firing was conducted using the control sights.

2.3.5 Analysis

2.3.5.1 The criteria in para 2.3.2.1 were reported met in the first partial report. There was no change in the status of results relative to these criteria from the subsequent testing and the test item was considered safe to operate and maintain.

2.3.5.2 Results indicated that there were no flash and glare problems when firing the test item from the M60 machinegun. The criteria in para 2.3.2.2 were met.

2.4 ALIGNMENT AND ZERO

2.4.1 Objectives

2.4.1.1 To determine if adjustments for zeroing permit proper alignment of the test item with the weapons.

2.4.1.2 To determine the adequacy of the test item with respect to weapon/test item alignment retention.

2.4.2 Criteria (Essential)

2.4.2.1 . . . Mounting brackets will permit quick, simple attachment of the sight to the weapon in darkness. The brackets must allow repeated mounting and dismounting of sights without significant change in zero. Bore sighting may be required when weapons and sights are intermixed (QMR, para 8c).

2.4.2.2 Design will make provision for indication of clicks both audibly and in a manner sensitive to touch to facilitate zeroing. Zeroing procedures will be essentially the same as for standard daylight sights (QMR, para 8m).

2.4.3 Method

2.4.3.1 The test items were mounted on the flexibly mounted M60, 7.62MM machinegun on the M114A1 Command and Reconnaissance Vehicle. With the test items mounted and aligned, the M60 machinegun was zeroed at a range of 400 meters.

2.4.3.2 The above procedures were repeated with operators wearing military gloves.

2.4.3.3 Following initial boresighting and referral of the test item to match the daylight sight zero alignment, the M114A1 was operated 50 miles over secondary roads and 50 miles over cross-country terrain. The test items and weapon combination were fired at the completion of each 25 miles to check retention of the adjusted zero.

2.4.3.4 During hours of darkness, the test items, in turn, were removed and remounted on the M60 machinegun a total of 10 times. The weapons were fired after each repetition to check retention of the adjusted zero.

2.4.3.5 The test item was removed and a second test item was substituted on the M60 machinegun a total of five repetitions. The effect or interchange of sights on adjusted zero and necessity for realignment, if any, was determined.

2.4.3.6 Test soldiers with normal hearing (Profile 1) adjusted the sights using both audible and touch sensitive clicks.

2.4.3.7 The M60 machinegun was zeroed during daylight hours with standard daylight sights and during darkness with the test item. A comparison was made of the procedures required in each case.

2.4.4 Results

2.4.4.1 No difficulties were encountered when mounting the test items on the M60 machinegun. Difficulties were encountered in obtaining a saddleblock for mounting the control sights, but once obtained, no further difficulties were encountered in mounting the AN/TVS-2B on the M60 machinegun. The procedures outlined in the draft -12 manual for zeroing the test item at close ranges were incomplete in that they did not specify the location of round impact at 25 meters for the M60 machinegun. NVL was contacted and they provided guidance for zeroing

procedures at 25-meter targets. No further difficulties were encountered with zeroing the test or control items.

2.4.4.2 No major difficulties were encountered with operators mounting and zeroing the test and control sights while wearing military gloves. Results of this phase are included in para 2.10.4.

2.4.4.3 The test and control items retained their zeros after 50 miles of secondary road operation. After 50 miles of cross-country travel, the following shifts in zeros were noted:

Serial No	Type Sight	Shift (Mils)	Direction
95-112	AN/PVS-4	4.57	Left
95-113	AN/PVS-4	3.05	Left
1108	AN/PVS-2B	2.28	Up
27967	AN/PVS-2B	0.0	-

2.4.4.4 Both the test and control sights retained their zero after each repetition of the mounting - dismounting cycle.

2.4.4.5 No adjustments were necessary when a second test sight was substituted on the M60 machinegun when that sight had been previously zeroed on the mounting bracket. Interchanging brackets on the M60 machinegun caused the test item's zero to shift vertically approximately 1-1/2 mils after five repetitions.

2.4.4.6 Test soldiers with normal hearing (Profile 1) encountered no difficulties when adjusting the test sights using both audible and touch sensitive clicks. One test soldier with a hearing Profile 3 likewise had no difficulties using the audible and touch sensitive clicks. The adjustment knobs on the comparison sights were worn and difficult to adjust.

2.4.4.7 Daytime and darkness zeroing procedures were essentially the same for the "iron sights" and test and comparison items. As noted in para 2.4.4.1, assistance was provided by NVL in proper zeroing procedures for 25-meter targets with the AN/PVS-4. High illumination during daytime conditions obscured the reticle and made it impossible to zero the test and comparison item until the illumination level had decreased. This occurred with the reticle on full power and the cover on the smallest light opening. No other problem areas were encountered with daytime and darkness zeroing procedures for the test and comparison items.

2.4.5 Analysis

2.4.5.1 The mounting brackets for the M60 machinegun permitted quick, simple attachment of the test sights to the weapon in darkness. In

addition, the AN/TVS-5, Crew Served Weapon Sight can also be mounted on this same mounting bracket. Test results show that the brackets allow repeated mounting and dismounting of the test sights without significant change of zero. The criteria in para 2.4.2.1 were met. The loss of zero caused by intermixing weapons and sights was probably caused by different mating characteristics between various mounts and sights. Operators should be made aware that using a zeroed sight on a new mount might require rezeroing the weapon sight system. A suggested improvement is that the operator's manual make note of this fact. (See para 4, app C.)

2.4.5.2 The test items had audible and touch sensitive clicks for adjustment of zeros. Zeroing procedures with the test sights were essentially the same as for the standard daylight sights. The criteria in para 2.4.2.2 were met.

2.4.5.3 A deficiency is assessed against the test item for the inability to retain its adjusted zero after cross-country travel (para 2.4.4.3). Both of the test items and one of the control items experienced this problem. This is considered a deficiency since a loss of zero during normal combat operations will prevent the operator from bringing accurate fire on a target. (See para 1.1, app C.)

2.4.5.4 The problem of not being able to zero the weapon sight system during high illumination periods (para 2.4.4.7) is considered a shortcoming. (See para 2.1, app C.) This problem arises because of insufficient contrast between the reticle and the background as seen through the daylight cover. This is classified a shortcoming because the operator cannot zero his weapon throughout the major part of the day. He must wait until the illumination level decreases before beginning zeroing procedures.

2.4.5.5 The lack of complete instructions of zeroing procedures at 25-meter targets (para 2.4.4.1) is classified a shortcoming as it should be corrected to increase the employment accuracy of the weapon. (See para 2.2, app C.)

2.5 TARGET DETECTION, RECOGNITION, AND IDENTIFICATION

Complete results and analysis of this subtest are included in the first partial report, ref 2, app F. The percentages of targets detected, recognized, and identified under moonlight, starlight, and overcast conditions with the test items were 87.9 percent, 54.4 percent, and 34.2 percent, respectively. For the same light levels, the recorded percentages with the control sights were 82.2 percent, 60.0 percent, and 37.9 percent. Maximum recorded range with both the test and control sights was 1,200 meters. Illumination from a Xenon searchlight with pink filter improved sight capabilities. Both the test and control

sights were able to detect infrared emissions at 1,600 meters. Three essential criteria and one desirable criterion were met, the other desirable criterion was not met. (See items 8, 9, 10, 16, and 17, app B.)

2.6 HITTING PERFORMANCE

2.6.1 Objectives

2.6.1.1 To determine the ability of the test item to enable armored vehicle mounted weapons to engage combat-type targets during hours of darkness.

2.6.1.2 To determine the maximum ranges at which targets can be effectively engaged under various conditions of visibility, weather, and terrain.

2.6.2 Criteria (Essential)

2.6.2.1 Reticles will be designed so that the sight picture for each weapon . . . is as close as possible to the sight picture obtained with applicable daylight sight. The reticle shall not obscure the target by side flow effects. . . (QMR, para 81).

2.6.2.2 The sights will permit a hit probability equal to that obtained with the given weapon in daylight (QMR, para 1b).

2.6.2.3 Size . . . must not degrade . . . performance characteristics of weapons with which the sight is to be employed. . . (QMR, para 8b(1)).

2.6.3 Method

2.6.3.1 During daylight hours, after zeroing, utilizing standard daylight sights, the M60, 7.62MM machinegun mounted on an M114A1 was fired by three trained personnel at both stationary and moving targets. Stationary targets consisted of silhouettes (standing type), 25 each per range (100, 200, 300, 400, and 500) and 8- by 8-foot plywood panels, at ranges of 500, 700, 900, and 1,200 meters. Moving targets consisted of 8- by 8-foot panels at ranges of 400 and 600 meters. Standard combat mix ammunition, 100 rounds per range, was fired using standard burst techniques (6- to 9-round bursts). All exercises listed above were repeated at night with the test items mounted. Each exercise was conducted under conditions of measured ambient light (starlight and moonlight). (Heavy overcast conditions were not encountered during the test.) After each exercise the targets (silhouettes and panels) were examined and the target hits recorded.

2.6.3.2 The test item reticles were checked to determine if the target was obscured by side flow effects. Throughout testing, operating personnel compared the sight pictures obtained with daylight sights to those obtained with the test item at night.

2.6.3.3 Throughout testing, the operators looked for any difficulties in employment of the weapon due to size of the test item.

2.6.4 Results

2.6.4.1 Sight pictures for the test and control items were essentially the same as for daylight firing. "Blooming" caused by fired tracers was a problem with the comparison sights. This problem did not occur with the test items. The reticles did not obscure the target by side flow effects.

2.6.4.2 Detailed results of hitting performance for the M60 machinegun and night vision sight systems are listed in parts 2 and 3, app A. The type target, range, number of hits, and recorded light conditions are listed for each gunner and sight. The percentage of hits for the three gunners at combined ranges (stationary mode) between 100 and 1,200 meters are listed in Table 1 below:

TABLE 1

Sight	Condition	Percent Hits All Silhouettes From 100-500M	Percent Hits All Panels From 500-1,200M	Percent Hits Overall
Iron	Day	22.5	15.7	19.5
PVS-4	Moonlight	29.7	6.6	19.4
PVS-4	Starlight	23.5	2.8	14.3
PVS-2B	Moonlight	21.5	4.7	14.0
PVS-2B	Starlight	21.1	4.6	13.8

2.6.4.3 Fog decreased the hitting capabilities of both the test and comparison items. On four separate occasions, in fog, moving targets at 600 meters could not be detected with the comparison item (AN/PVS-2B). On these same occasions, the target was detected using the test item. On four other occasions, it was impossible to detect stationary targets at 1,000 meters with the comparison item, but was possible to detect these same targets with the test item.

2.6.4.4 No difficulties were encountered due to test item size when it was mounted on the M60 machinegun. No difficulties were encountered with the size of the control sight when mounted on the M60 machinegun.

2.6.5 Analysis

2.6.5.1 Test results indicated that sight picture obtained using the test item on the M60 machinegun was similar to that obtained using daylight sights. In addition, the sight picture obtained with the test item was superior to that of the control sight because it did not suffer from "blooming" effects and also allowed the gunners to detect targets better under fog conditions. The reticle did not obscure the targets by side flow effects. The criteria in para 2.6.2.1 were met.

2.6.5.2 The methodology employed in the analysis of hitting performance consisted of a chi square contingency test comparing various combinations of hitting performances. The combinations were: day firing versus moonlight and starlight firing with the AN/PVS-4; moonlight firing with the AN/PVS-4 and the AN/PVS-2B; and starlight firing with the AN/PVS-4 and the AN/PVS-2B. For stationary firing, a two-row (sights) x nine column (range) table with total hits pooled over the three gunners was used. Ranges with less than five total hits recorded were combined with other ranges. For moving target firing, the number of hits in each cell was too small to provide meaningful results, so the tables were reduced to a two-row (sights) x two column (hit-miss) table. For all such tables, the hypothesis being tested was that the samples were drawn from identical binomial populations (i.e., the proportion of hits was the same). For a significance level of 0.10, and 7 degrees of freedom (stationary), the tabled chi square value was 12.02, and for 1 degree of freedom (moving), the tabled chi square value was 2.71. A table of values for all comparisons is at part 4, app A. The analyses are:

a. For stationary M60 machinegun firing, there were two "iron" sight versus night sight comparisons, i.e., daylight firing versus moonlight firing with the test item, and daylight firing versus starlight firing with the test item. The computed chi square values for these two tests were 92.17 and 124.24, respectively. Since both values were greater than 12.02, there is reason to believe that there is a significant difference in the proportion of hits. While the night sight performed better at the three close-in ranges, it was poorer at the other five ranges and hence the criterion (para 2.6.2.2) of night firing with the test items being equivalent to day firing was not met. These results, however, do not adequately reflect the firing results. The failure of this criterion is not considered a deficiency since it is felt that this requirement may be beyond the state-of-the-art in current night vision sights. While the night sights did not present the same hitting performance as day firing,

it is the opinion of the project officer that the test item allowed the gunner to effectively engage targets.

b. For stationary M60 machinegun firing, there was a moonlight and a starlight comparison between the test and control sights. For the two comparisons, i.e., moonlight test item vs moonlight control item and starlight test item vs starlight control item, the computed chi square values were 23.24 (moonlight comparison) and 21.99 (starlight comparison) versus the tabled value of 12.02. This indicates that there is reason to reject the hypothesis of there being no significant difference in the proportion of hits between sights. These results indicate that the test sight performed better under both light conditions than did the control item. In addition, the test item performed better under fog conditions, and in the opinion of all test personnel, performed better than the control item.

c. Hitting performance against moving targets was extremely poor and is considered separately from the above analysis. The chi square test does not reject the stated hypothesis for daylight versus test item firing and indicates that there is no reason to believe that there is a significant difference between daylight firing and the test item firing for both moonlight and starlight conditions. The analysis rejects the stated hypothesis when comparing the test and control items. This indicates that the AN/PVS-4 (test item) performed better than the AN/PVS-2B (control item). These poor moving target results were due to two factors. One was the target speed. Initial familiarization firing was against moving targets at 7 - 10 MPH; however, the target background was illuminated by the skyglow from a town, and targets could only be identified when within 300 meters. Skyglow was eliminated at the record firing range; however, target speed varied from 5 - 15 MPH. This made engagement difficult. A second problem area arose with the sight reticles. The only "leadlines" for moving targets were the two surrounding the center dot. To effectively engage targets with this reticle, more leadlines at various ranges would have to be included in the reticle. However, too many leadlines might clutter up the sight picture and negate this improvement. A reticle would have to be designed and tested to thoroughly evaluate the pros and cons of including leadlines in the sight picture.

2.6.5.3 Test results indicated that the size of the test item did not degrade performance characteristics of the M60 machinegun. The criterion in para 2.6.2.3 was met.

2.6.5.4 In addition to firing with the M60 machinegun, limited firing was also performed with the M60D, i.e., the M60 with "spade" grips and "butterfly" trigger. Gunners were forced to assume a firing posture (i.e., both hands on the grip, hands close to the chest, and sighting over the top of the gun) that prevented accurate employment of the weapon-sight system. Gunners had to stretch to reach the eyepiece and could not fire and observe at the same time.

2.7 OBSERVATION AND SECURITY

Complete results and analysis of this subtest are included in the first partial report, ref 2, app F. The test criteria in this subtest were met. (See items 18 and 19, app B.)

2.8 RELIABILITY AND DURABILITY

2.8.1 Objective

To determine the reliability and durability of the test item.

2.8.2 Criteria

2.8.2.1 (Essential) Sight must withstand rough handling associated with transportation and use during combat operations (QMR, para 8d).

2.8.2.2 (Essential) Sight must withstand the shock of repeated firings without damage or change of adjustment (QMR, para 8j).

2.8.2.3 (Essential) Normal combat life of this item (Mean Time Between Failure not including operator maintenance requirements) will be 1,000 operating hours, 2,000 operating hours (desirable) (QMR, para 8d).

2.8.2.4 (Essential) Sensor life will be at least 1,000 hours, 2,000 hours (desirable) (QMR, para 8d).

2.8.2.5 (Essential) . . . Minimum battery life will be such that the sight can be operated continuously for at least 12 hours without replacement. . . (QMR, para 8i).

2.8.2.6 (Essential) Sights must be moistureproof and dustproof (QMR, para 8o).

2.8.3 Method

2.8.3.1 The test items with carrying case were stowed in an appropriate location (as determined by stowage test, para 2.2) on the M114A1 and transported 150 miles over highway, secondary roads, and cross-country. The test items were then inspected for damage. Subsequently, the test items were mounted on the M60, 7.62MM machinegun, on the M114A1 and transported another 150 miles during the hours of darkness. With the test item mounted, the operational capability was checked every 10 miles. Mileage consisted of approximately 20 percent highway, 40 percent secondary roads, and 40 percent cross-country. Table 2 below reflects all mileage, including that accumulated during the alignment and zero subtest.

TABLE 2

Vehicle and Mode of Transport	Type of Operation	Test Item Serial Number 95-112	95-113	Control Item Serial Number 1108	27967
		Miles		Miles	
Stowed in M114A1	Cross-Country	60.7	60.7	90.0	90.0
	Secondary	63.5	60.0	91.5	91.5
	Highway	75.8	72.8	59.0	59.0
Mounted on M60 Machinegun on M114A1	Cross-Country	60	60	60	60
	Secondary	60	60	60	60
	Highway	30	30	30	30
	TOTAL MILES	350.0	343.5	390.5	390.5

2.8.3.2 Each test and control item was subjected to shock and vibration effects from 2,000 rounds of 7.62MM firing. Additionally each test and control item was used to fire approximately 7,000 rounds during the hitting performance subtest, for a total of 9,000 rounds shock and vibration firing for each sight.

2.8.3.3 Before and after all functional testing, the test and control sights were operated continuously for 12-hour periods to accumulate the maximum hours possible. Total operating time accumulated on the two test items was 2,072.5 hours. The hours accumulated on the test and control sights were as follows:

TABLE 3

Serial Number	Hours	Type Sight
Test Items		
95-112	1,060.75	AN/PVS-4
95-113	1,011.75	AN/PVS-4
Control Items		
1108	385.75	AN/PVS-2B
27967	376.25	AN/PVS-2B

The low number of hours (762.0) accumulated on the control sights resulted from battery rationing because of two shipments of bad batteries.

2.8.3.4 A record of all failures was maintained throughout the test. A failure was defined as any malfunction which the operator/crew could not remedy by adjustment, repair, or replacement action using the controls, OEM tools, and OEM parts within 10 minutes and which causes or may cause:

a. Failure to commence operation, cessation of operation, or degradation of performance capability of system/subsystem below designated levels.

b. Serious damage to system/subsystem by continuous operation.

Simultaneous related malfunctions were considered as one failure.

2.8.3.5 At the completion of functional testing, each test item was operated for a minimum of 12 continuous hours with new batteries. This exercise was repeated five times for each test item.

2.8.3.6 Throughout testing, the test items were periodically visually inspected for signs of moisture and dust within the test items.

2.8.3.7 A log for each battery was maintained. The following was recorded:

a. Daily and accumulated operating time

b. Temperature range

c. Precipitation, if any.

2.8.4 Results

2.8.4.1 During the first phase of testing that was suspended in January 1973, four deficiencies were experienced in the area of reliability and durability (ref 2, app F). The deficiencies were:

a. The image intensifier tube developed a burnt spot

b. The threads on the plastic reticle cell housing failed

c. The rear retaining ring loosened

d. The locking knob on the M60 machinegun mounting bracket fell out.

These and other areas were the subject of corrections and modifications applied by NVL to the sight after test suspension.

2.8.4.2 The test and control sights suffered no damage or adverse effects to their operational capabilities during the final testing phase as a result of mounted or stowed transportation on the M114 vehicle.

2.8.4.3 One chargeable system failure was experienced by the test items during the final testing phase (the chargeable system failure and the associated repair operation are listed in part 1-B, app D) as a result of rough handling associated with normal use during simulated combat operations. The rubber eye guard on test sight No 95-112 came off after 602.0 hours of sight operation. The control sights experienced no chargeable system failures during the final testing phase.

2.8.4.4 The test and control sights suffered no damage or adverse effects during the final phase of firing as a result of the approximately 9,000 rounds of 7.62MM M60 machinegun fire.

2.8.4.5 No system failures of the image intensifier tubes (sensors) occurred during the final phase of the test.

2.8.4.6 Tables containing the results of battery life are included in part 5, app A. Test sight batteries are listed in pairs as both batteries were exchanged at the same time. Each set of batteries operated continuously for at least 12 hours without replacement, and average battery life for both test sights was 71.47 hours.

2.8.4.7 No moisture was detected inside of the test items or control sights. During cross-country travel with test sight No 95-113 mounted on the M114, three black spots were noted in the sight picture. These spots were determined to be dust particles and were removed when the sight was disassembled and cleaned. No other instances of dust particles inside the test or control sights were noted.

2.8.5 Analysis

2.8.5.1 Test results from both phases of testing indicated no adverse effects on the operational capabilities of the test items due to mounted or stowed transportation. The part of the criteria in para 2.8.2.1 pertaining to transportation was met and is consistent with the findings of the first partial report. The failure assessed against the test item when the rubber eye guard came off indicated that the test sight could not withstand the rough handling associated with use during simulated combat operations. Consequently, the criteria in para 2.8.2.1 were not met. This failure is discussed further in para 2.8.5.5.

2.8.5.2 Results from the first phase of testing indicated no chargeable failures resulted to the test item due to firing with the M60 machinegun. Since the test item withstood the shock of repeated firings without damage or change of adjustment during the final testing phase, the criteria in para 2.8.2.2 were met.

2.8.5.3 Reliability calculations assuming an exponential failure distribution were made with data collected on the modified test sights. From test reinitiation in April 1974 to test completion, one chargeable system failure occurred during 2,072.5 hours of testing. A two-sided 80-percent confidence interval estimate was computed using the following formula:

$$\frac{2T}{X^2_{.10;\,2r+2}} \leq MTBF \leq \frac{2T}{X^2_{.90;\,2r}}$$

Where T = Total operating hours of all test items (2,072.5)

r = Number of failures (1)

$X^2_{.10;\,2r+2}$ = X^2 distribution value from table H-3b, AMCP 702-3 (7.779)

$X^2_{.90;\,2r}$ = X^2 distribution value from table H-3a, AMCP 702-3 (.211)

Based on the above computation, the upper-level MTBF is no greater than 19,644.55 hours and the lower level MTBF is at least 532.84 hours. The total of one failure in 2,072.84 hours of testing indicates that the point estimate equals 2,072.84 hours. The wide range between the lower and upper 80-percent confidence limits is a result of the large variability inherent in the exponential distribution itself, and the fact the amount of testing is relatively small in comparison to the point estimate of MTBF. Additionally, the validity of the stated criterion is questionable, i.e., the requirement is a QMR statement and therefore does not follow the current guidance provided in AR 702-3, which calls for reliability to be stated as two distinct values; the "minimum acceptable value" and the "specified value". Both of these values are to be agreed on by the combat and materiel developers. Two values are provided, i.e., 1,000 MTBF (essential) and 2,000 MTBF (desirable); however, there is no reason to believe that they are to be equated to the MAV or a specified value. It is for these reasons that no attempt has been made to assess the criterion in terms of met-not met. If appropriate, this assessment will be made by HQ TECOM based on the data provided by all test agencies.

2.8.5.4 Reliability calculations on sensor life were made with data collected on sensors employed in the modified sights. From test reinitiation to test completion, no chargeable sensor failures were recorded during the 2,072.5 hours of testing. Using the technique described in para 2.8.5.3 gives a lower-level MTBF of at least 900.11 hours. The upper level and point estimate of MTBF were not computed since there were no sensor failures. However, 2,072.5 hours of

operation without a failure indicates there is 88 percent confidence that the MTBF is at least 1,000 hours. For the same rationale provided in para 2.8.5.3, no assessment was made of the criterion in terms of met, not met.

2.8.5.5 The analysis in para 2.8.5.1 has indicated that criteria in para 2.8.2.1 were not met because of the failure of the rubber eye guard. This incident is classified a deficiency, because without the eye guard the gunner cannot effectively fire the weapon - sight system, and tube brightness illuminates the gunner's face and compromises his position. (See para 1.2, app C.) This incident occurred only once during both phases of testing at the USAARENBD and would generally be considered as a nonpattern failure, i.e., not characteristic of the item. However, at the time of this report submittal, four instances of this same problem have occurred at the USAIB where concurrent testing with the AN/PVS-4 is being conducted. Therefore, when these incidents are considered, there is reason to believe that this type of failure may be a sight design.

2.8.5.6 During the first phase of the test, a deficiency was assessed against the test item because of image intensifier tube malfunctions. Although calculations on sensor life were not made during first phase of testing, the test sights had one failure in 880.4 combined hours of operation. No difficulties were experienced with the image intensifier tubes during the final test phase and the two sights had no failures in 2,072.5 hours of operation. (See para 2.8.5.3.) The applied modifications apparently increased the sensor life. At the time of this test report there were two tube failures with the AN/TVS-5 (this sight uses the same image intensifier tube as the AN/PVS-4) that underwent concurrent testing at the USAARENBD (see ref 7, app F), and four tube failures at other locations (USAIB) testing the AN/PVS-4 indicating that possible problems still exist with the image intensifer tubes. However, the two tubes tested in the AN/PVS-4's performed without experiencing any failures and the deficiency assessed against the test item in the first phase of testing is considered a corrected deficiency. (See para 3.5, app C.)

2.8.5.7 During the first phase of testing, a deficiency was assessed against the test item because the locking knob on the M60 machinegun mounting bracket fell out. This problem was not addressed in the modifications applied to the test sight. While there was not a recurrence during the final testing phase, the locking knob that secured the AN/TVS-5 to its bracket suffered the same problem when firing the Cal .50 machinegun. (See ref 7, app F.) As the same type locking pin is used in both sights, vibrational firing effects, or improper crew tightening apparently caused the locking knobs to come loose. This incident is downgraded to an uncorrected shortcoming because periodic knob tightening by the operator will keep the sight firmly affixed to the bracket. (See para 2.3, app C.)

2.8.5.8 Two other deficiencies were assessed against the test item during the first phase of testing. The setscrews in the rear retaining ring loosened and allowed the rear retaining ring to separate from the range focus ring. A new focus ring, and a change in the slipring and setscrew material were part of the modifications applied to the sights. No further difficulties were experienced with the above problem and the deficiency is considered corrected. (See para 3.2, app C.) Reticle cells were modified to use a different material and the failure of the reticle housing did not recur. The deficiency is considered corrected. (See para 3.3, app C.)

2.8.5.9 Results from testing conducted over the entire test period have indicated that minimum battery life is such that the sight can be operated continuously for at least 12 hours without replacement in the temperature range of this test. The criterion in para 2.8.2.5 was met.

2.8.5.10 Test results indicated that the sight was moistureproof, therefore, that portion of the criteria in para 2.8.2.7 was met. The portion of the criteria in para 2.8.2.7 pertaining to the sight being dustproof was not met. However, the dust that entered one sight (para 2.8.4.7) did not degrade the performance of the sight and was removed by maintenance personnel. Since this incident only occurred once during the total testing period, it is classified a non-pattern occurrence.

2.9 MAINTENANCE EVALUATION

2.9.1 Objectives

2.9.1.1 To record data pertaining to maintenance required to keep the test item operational.

2.9.1.2 To determine the adequacy of the maintenance package.

2.9.2 Criteria

Not used.

2.9.3 Method

2.9.3.1 Evaluation of the maintenance package was limited to maintenance required to keep the test sight operational.

2.9.3.2 Data were obtained during the performance of daily, scheduled, and unscheduled maintenance. Operator and organizational maintenance was performed under simulated field conditions. Failed components were identified. Each malfunction was examined to determine if it was a

chargeable failure. (See definition in para 2.8.3.4.) All scheduled and unscheduled maintenance was recorded by level of maintenance, maintenance task, total active maintenance time (man-hours/clock-hours) expended per maintenance task. Only one repairman was used per maintenance task.

2.9.3.3 Each tool furnished and used in support of the test sight was examined. The operator/repairman used the tools in the manner prescribed either in the operator's or in the higher level maintenance manuals furnished for the test sight.

2.9.3.4 The equipment publications provided in the maintenance package were reviewed for adequacy and accuracy of instructions for each maintenance task performed in support of the test sight.

2.9.3.5 All maintenance operations were performed by the direct support level repairman (MOS 35E) and each task was observed. Observations were made for difficulties in installation, alignment, and interchangeability of parts.

2.9.3.6 The organizational level maintenance functions, including preparation and maintenance of DA Forms, were subjectively evaluated to determine the skill level and training required to realistically perform record keeping requirements.

2.9.4 Results

2.9.4.1 A record (by maintenance level) of man-hours/clock-hours expended in the performance of maintenance on the test sights follows:

a. Operator daily checks and services required a total of 17.4 clock-hours and 17.4 man-hours (an average of .19 CH/MH per item per day) for both test items.

b. Tabulated data for scheduled and unscheduled maintenance for each test sight, by level of maintenance, are shown in table 4 below. (See also part 1-B, app D, for a record of malfunctions, chargeable system failures, and failed components.) This includes maintenance performed from 30 Apr 74 to 12 Aug 74.

TABLE 4

MAINTENANCE DATA

	Serial No 95-112	Serial No 95-113	Total
Total Test Hours	1,060.75	1,011.75	2,072.50
Daily Operator Checks and Services Time (CH/MH)	8.7/8.7	8.7/8.7	17.4/17.4
Organizational Scheduled Time (CH/MH)	1.0/1.0	1.0/1.0	2.0/2.0
Organizational Unscheduled Time (CH/MH)	0/0	0/0	0/0
Direct Support Time (CH/MH)	0.6/0.6	0.8/0.8	1.4/1.4
General Support Time (CH/MH)	0/0	0/0	0/0
Total Active Maint Time (CH/MH)	1.6/1.6	1.8/1.8	3.4/3.4
Number of Failures	1	0	1
Total Time to Repair Failure (CH/MH)	0.6/0.6	0/0	0.6/0.6

2.9.4.2 Repair Parts. For a record of repair parts used, see part 2, app D. All repair parts used in the test fit and functioned properly. A list of parts furnished, compared with those used during testing, is contained at part 5-B, app D.

2.9.4.3 Tools. (See part 4-B, app D for a list of tools received for evaluation.)

a. The requirement for Gauge, Thickness Set (FSN 5210-221-2013) to check the clearance between the objective housing and the objective contact on early model AN/PVS-4 sights (see para 2.9.4.3a of the first partial report (ref 2, app F)) has been eliminated by modification of this sight. (See para 3.4, app C.)

b. The following tools (listed in DTM 11-5855-213-12 and furnished to support maintenance for the test) are available in common tool sets and are not considered special tools:

(1) Multimeter, TS-352 B/U, FSN 6625-242-5023

(2) Tool Kit, TK 101, FSN 5180-064-5178

(3) Tool Kit, TK 105/G, FSN 5180-610-8177.

2.9.4.4 Equipment Publications. See part 3-B, app D for a list of publications used. DTM 11-5855-213-12, DTM 11-5855-213-20P, DTM 11-5855-213-34, and DTM 11-5855-213-34P were provided for operational and maintenance support of the test item. Discrepancies noted in the -12, -34, and -34P are summarized below:

a. DTM 11-5855-213-12. The manual contained the following discrepancies:

(1) Clarity of figure illustrations throughout the manual was poor.

(2) Some referenced instructions are improper in that they do not relate to the cited subject.

(3) Three items were listed as special tools, when they are actually common tools available in the Army inventory (para 2.9.4.3b, above).

b. DTM 11-5855-213-20P. Use of this manual during testing failed to uncover any technical errors. All instructions used were clearly understood and all illustrations/printing were easily read.

c. DTM 11-5855-213-34. In addition to the discrepancies reported in the first partial report (ref 2, app F), the following discrepancies were noted:

(1) Clarity of figure illustrations was poor.

(2) Three items listed as special tools and test equipment were actually common tools (para 2.9.4.3b, above).

d. DTM 11-5855-213-34P. The manual contained the following discrepancies:

(1) Clarity of figure illustrations is poor, i.e., figure 1, page I-9, figure 2, page I-11, and figure 13, page I-33.

(2) Federal Stock Numbers are not provided in column (2) for numerous repair parts listed in the manual.

(3) The listing of many repair parts in the manual is inconsistent, causing much difficulty in locating parts; i.e., see the figure number column (10a) on pages II-2 through II-16 in Section II.

(4) The identification list for figures 1 through 13 on page I-13 is superfluous in that it duplicates the repair parts list in Section II.

(5) The small print used in the description column (3) is so blurred that the identification of a specific item, in some instances, is extremely difficult.

The manuals are not in conformance with pertinent DA regulations.

2.9.5 Analysis

2.9.5.1 The tools and test equipment noted in para 2.9.4.3b, above, are still not required as stated in para 2.9.4.3b of the first partial report (ref 2, app F).

2.9.5.2 The equipment publications (less the -20P) contain discrepancies that should be corrected to improve maintenance efficiency. (See para 1.3.1, app C.)

2.9.5.3 The QMR prescribes that organizational maintenance be performed by the armorer. He is not capable (lack of skill) of performing the prescribed maintenance in accordance with the 12 manual (para 2.9.3.6). The maintenance support plan, a later document than QMR, designates the operator to perform organizational maintenance. This is not in conformance with Army maintenance standards. Essentially, organizational level maintenance functions including preparation, and maintenance of DA Form 314, parts catalogues, tools, DA Form 2407 (Job Order), and DA Form 2402 (turnin tags) on the sight are necessary. The operator, who may be expected to live in a foxhole in combat, cannot be expected to meet the recordkeeping requirement. Additionally, the direct/general support facilities the sight may require, are normally found in the Division Support Command area, nearly 20 miles to the rear of the FEBA. An operator could not be expected to travel this distance to get a sight, or a sight component repaired. The following solution to this problem is offered:

a. Assign the direct/general support maintenance responsibility to MOS 35E (Special Electrical Devices Repairman), presently found at the DS/GS level of all division support commands.

b. Assign the organizational maintenance responsibility to MOS 31B (Field C-E Equip Mechanic), as an item of "selected equipment" for which he is responsible by MOS job description. The MOS 31B is found in all units likely to be issued the individual weapons sight. Furthermore, the MOS 31B training would require a minimum of orientation on the sight (estimated 2-3 hours) to fully meet the additional responsibility.

2.9.5.4 The failure to realistically designate a repairman to perform organizational maintenance is part of the deficiency assessed against the maintenance test package. (See para 1.3.2, app C.) In view of the above, (para 2.9.5.2 and 2.9.5.3) the maintenance test package is considered to be inadequate. (See para 1.3, app C.)

2.10 HUMAN FACTORS ENGINEERING

2.10.1 Objective

To determine whether the test item is suitable with respect to human factors engineering aspects and compatible with the skills, aptitudes, and limitations of personnel who will operate and service it.

2.10.2 Criteria

2.10.2.1 The equipment will be designed in accordance with good human factors engineering practice. The equipment will be considered as a component of a man-machine system and will be developed with full consideration for the intellectual, physical, and psychomotor capabilities of the intended user and maintenance personnel. Arrangement, size, and shape of operator control will permit ready tactical identification and adjustment in darkness. The equipment will be operable by personnel wearing . . . protective masks. Appropriate manuals detailing operating and maintenance procedures will be provided (QMR, para 10a).

2.10.2.2 The weight and balance of the sight will be such as to minimize operator fatigue and not adversely affect the balance and other firing characteristics of the weapon (QMR, para 10b).

2.10.2.3 (Essential) Access to knobs or switches will be convenient from any of the normal firing positions. Adjustment will be practicable for an operator wearing gloves. . . (QMR, para 8n).

2.10.3 Method

2.10.3.1 The operating instructions and safety release were examined and all restrictions and precautions contained therein were adhered to throughout the test.

2.10.3.2 Any difficulties experienced in operation of the test items, discomforts suffered, safety hazards encountered, and areas where improvement could be made were recorded.

2.10.3.3 Throughout the test, operators were instructed to report any inconvenience noted in the accessibility of the knobs or switches from any of the normal firing positions. Accessibility was also evaluated during the alignment and zero subtest (para 2.4) both with and without the operators wearing military gloves.

2.10.3.4 A human factors engineering evaluation questionnaire was answered by all three test gunners after the conclusion of testing.

2.10.4 Results

2.10.4.1 Results from the first partial report (ref 2, app F) indicated that experienced operators had no difficulties with locating and manipulating the test item control knobs and switches with or without gloves. The equipment was operable with the operators wearing the M25A1 protective masks. All four of the test personnel surveyed during the first partial report stated that they preferred the test sight over the control sight.

2.10.4.2 Test results during the final testing phase indicated that the mounted test sight produced no adverse effects upon the balance, or other firing characteristics, of the M60 machinegun. Gunners felt that the light weight of the test item made it more compatible with the machinegun than the heavier control sights.

2.10.4.3 All operators reported that they experienced a partial loss of their "unaided" night vision after using the test items. (This was the same as the effect when viewing through the AN/TVS-5.) Loss of night vision was also experienced with the control sights, but the effects were judged to last longer when using the test sights.

2.10.4.4 The evaluation questionnaires were the same as those used during the first partial report. Informal interviews revealed that all three of the test personnel preferred the test sight over the control sight, and that the test item was a valuable night vision aid. At least one crewmember thought that some of the controls on the test item were not sensitive to touch when the operator was wearing military gloves. For detailed results of questionnaires, see part 6, app A.

2.10.5 Analysis

2.10.5.1 The partial loss of an operator's unaided night vision after sight use is not considered critical when compared with the overall benefits of the test sight. The operator's unaided night vision is not destroyed, but reduced in the eye used for sighting. Results from both phases of testing indicate that the criteria in para 2.10.2.1 were met.

2.10.5.2 Results indicated that the balance and other firing characteristics of the M60 machinegun were not affected by the mounted test sight. The criteria in para 2.10.2.2 were met.

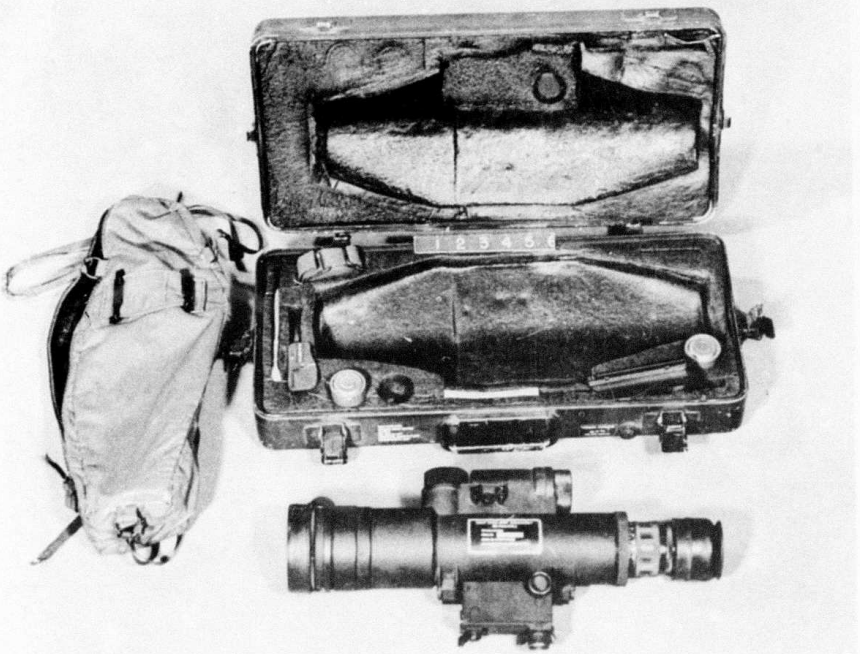
2.10.5.3 The portion of criteria in para 2.10.2.3 concerning access to knobs or switches was met. Test questionnaire results, on locating and adjusting controls while wearing military gloves, were not completely favorable in both surveys. The controls on the test sights were essentially the same for both test crews. Since the subjective opinions in both test periods indicate that this is a problem, the criteria in para 2.10.2.3 concerning adjustment by operators wearing gloves was not met. This is a change from the first partial report which considered the criteria met. However, this is not considered critical and a shortcoming or deficiency is not assessed against the test item, since this problem could be overcome through additional training and use.

SECTION 3. APPENDIXES

APPENDIX A. TEST DATA

Table of Contents

PART I. PHOTOGRAPHS

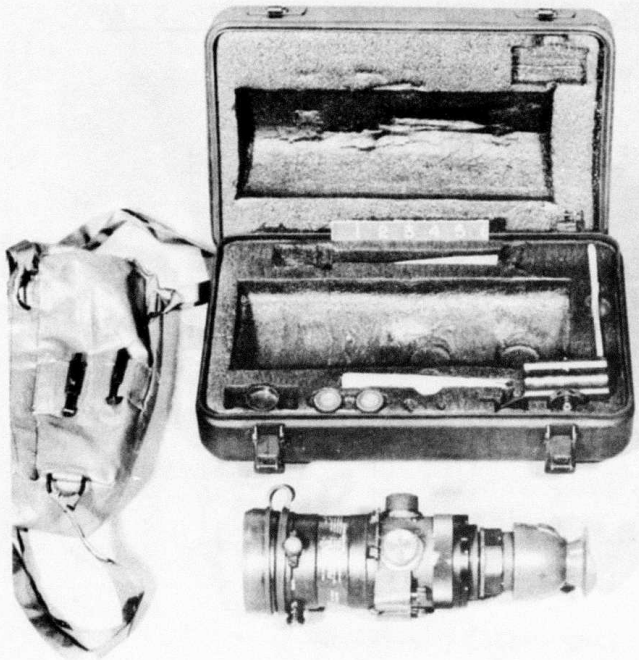


US ARMY ARMOR AND ENGINEER BOARD FORT KNOX KY	**TECOM PROJ NO** 7-ES-315-SLS-002 **PHOTO NO** 72-319

NIGHT VISION SIGHT, INDIVIDUAL SERVED WEAPONS

AN/PVS-2, SMALL STARLIGHT SCOPE WITH CARRYING CASE, SHIPPING CASE AND ACCESSORIES

STEBB-LT-P Form 1
1 Apr 74
Photo & Graphics Br SOP



US ARMY ARMOR AND ENGINEER BOARD FORT KNOX KY	TECOM PROJ NO 7-ES-315-SLS-002 PHOTO NO 72-318
NIGHT VISION SIGHT, INDIVIDUAL SERVED WEAPONS AN/PVS-4 INDIVIDUAL SERVED WEAPONS NIGHT VISION SIGHT WITH SHIPPING CASE, CARRYING CASE, AND ACCESSORIES	

STEBB-LT-P Form 1
1 Apr 74
Photo & Graphics Br SOP

PART 2. HITTING PERFORMANCE AGAINST STATIONARY TARGETS

"Iron" Sights - Day Fire

	Range								
	100	200	300	400	500	500	700	900	1,200
		(Silhouettes)					(Panels)		
Gunner 1	46	32	10	29	25	28	23	14	1
Gunner 2	57	22	16	16	10	35	20	23	5
Gunner 3	25	15	8	12	15	22	10	7	1
TOTALS	128	69	34	57	50	85	53	44	7

AN/PVS-4 (Moonlight)

Gunner 1	74	27	10	17	6	15	6	4	2
Gunner 2	64	48	18	4	7	15	6	6	1
Gunner 3	79	42	12	17	20	17	4	3	0
TOTALS	217	117	40	38	33	47	16	13	3

AN/PVS-4 (Starlight)

Gunner 1	59	47	6	22	11	8	3	2	0
Gunner 2	15	54	7	23	3	9	4	1	0
Gunner 3	40	25	27	8	5	1	4	1	0
TOTALS	114	126	40	53	19	18	11	4	0

AN/PVS-2 (Moonlight)

Gunner 1	38	32	18	9	12	13	7	2	1
Gunner 2	35	21	19	15	6	11	9	3	0
Gunner 3	40	35	16	16	11	7	2	1	0
TOTALS	113	88	53	40	29	31	18	6	1

AN/PVS-2 (Starlight)

Gunner 1	21	10	11	20	11	13	1	0	0
Gunner 2	52	38	23	24	0	11	6	4	0
Gunner 3	28	31	20	17	11	15	5	0	0
TOTALS	101	79	54	61	22	39	12	4	0

NOTE: 100 rounds were fired for each range by each gunner.

PART 3. HITTING PERFORMANCE AGAINST MOVING TARGETS

"Iron" Sights - Day Fire

	Range 400	600
Gunner 1	3	10
Gunner 2	9	3
Gunner 3	5	0
TOTALS	17	13

AN/PVS-4 (Moonlight)

Gunner 1	5	5
Gunner 2	6	5
Gunner 3	10	4
TOTALS	21	14

AN/PVS-4 (Starlight)

Gunner 1	2	0
Gunner 2	4	6
Gunner 3	5	6
TOTALS	11	12

AN/PVS-2 (Moonlight)

Gunner 1	0	0
Gunner 2	3	5
Gunner 3	9	5
TOTALS	12	10

AN/PVS-2 (Starlight)

Gunner 1	1	2
Gunner 2	3	0
Gunner 3	1	3
TOTALS	5	5

NOTE: 100 rounds were fired for each range by each gunner.

PART 4. CHI SQUARE RESULTS

Comparison	Weapon System	Target Posture	Chi Square Values
Day vs PVS-4 (Moonlight)	M60	Stationary	92.17
Day vs PVS-4 (Starlight)	M60	Stationary	124.24
PVS-4 (Moon) vs PVS-2 (Moon)	M60	Stationary	23.24
PVS-4 (Star) vs PVS-2 (Star)	M60	Stationary	21.99
Day vs PVS-4 (Moonlight)	M60	Moving	.41
Day vs PVS-4 (Starlight)	M60	Moving	.97
PVS-4 (Moon) vs PVS-2 (Star)	M60	Moving	3.11
PVS-4 (Moon) vs PVS-2 (Star)	M60	Moving	5.27

PART 5. BATTERY LIFE

Test Sight No 95-112

Batteries (Sets)	Total Battery Life (Hours)	Temperature (Degrees F)	Precipitation (Inches)
1	72.0	46 - 72	1.06
2	72.0	43 - 84	1.24
3	72.0	71 - 86	.14
4	48.0	58 - 81	.42
5	31.25	54 - 80	3.11
6	74.0	61 - 82	.51
7	74.5	62 - 84	1.03
8	94.0	52 - 82	.01
9	97.5	52 - 89	.17
10	68.5	52 - 89	.43
11	71.0	60 - 85	.12
12	79.25	66 - 91	.31
13	88.75	67 - 90	1.00
14	94.0	61 - 88	.05
15	24.0	68 - 72	.00
TOTAL 15 SETS (30 Batteries)	1,060.75		9.60
Average	70.72		.64
Range	24.0 - 97.5	43 - 91	.00 - 3.11

Test Sight No 95-113

Batteries (Sets)	Total Battery Life (Hours)	Temperature (Degrees F)	Precipitation (Inches)
1	72.0	46 - 72	1.06
2	72.0	43 - 84	1.24
3	72.0	71 - 86	.14
4	72.0	54 - 81	3.53
5	81.25	55 - 84	1.54
6	98.50	52 - 82	.01
7	46.0	54 - 81	.00
8	48.0	68 - 89	.17
9	97.0	52 - 89	.43
10	67.0	60 - 91	.29
11	70.0	61 - 90	1.14
12	96.0	63 - 88	.05
13	96.0	57 - 89	.03
14	24.0	68 - 72	.00
TOTAL 14 SETS (28 Batteries)	1,011.75		9.63
Average	72.27		.69
Range	24.0 - 98.5	43 - 91	.00 - 3.53

COMBINED SIGHTS

Total Life (Hr)	2,072.50
Average Life (Hr)	71.47

PART 6. RESULTS OF HUMAN FACTORS ENGINEERING QUESTIONNAIRE

The following questions apply to the DT II (Service Phase) of Night Vision Sight, Individual Served Weapons:

1. Overall, which of these two sights do you feel performed better?

   3 AN/PVS-4 (test)
   ____ AN/PVS-2B (control)

2. How would you rate the ease of using the test sight?

   3 Very easy
   ____ Easy
   ____ Fair
   ____ Difficult
   ____ Very difficult

3. How would you rate the ease of using the control sight?

   3 Very easy
   ____ Easy
   ____ Fair
   ____ Difficult
   ____ Very difficult

4. Which sight caused the least fatigue when used for long periods of time?

   1 Test sight
   ____ Control sight
   2 No difference
   ____ Not sure

5. Which sight permits the most stable and comfortable grip?

   3 Test sight
   ____ Control sight
   ____ No difference
   ____ Not sure

6. The test sight incorporates several features which are not characteristic of the control sights. A list of these appears below. Some of these features are obviously more important than others. In order that their importance might be evaluated, you are to rank them according to their relative merit. If you feel that a particular characteristic is the most significant improvement over the control sight then that characteristic should be assigned a value of 1. The characteristic which is considered the least significant improvement

should be assigned a value of 5. Each characteristic can be assigned only one value and each value can be assigned to only one characteristic.

a.	Wide field of view	5	3	1	____
b.	Automatic brightness control	2	2	3	____
c.	Lighter weight	1	1	2	____
d.	Location of objective focusing ring	4	4	4	____
e.	Smaller battery	3	5	5	____

7. Did the tube brightness control on the test sight help you to obtain a better sight picture?

3 Yes
____ No
____ Don't know

8. During observation exercises, test personnel differed in opinion as to the best method of regulating the tube brightness control knob. Which method most closely describes the manner in which you regulated the control?

____ I always kept the picture as bright as possible.
2 I regulated the brightness control knob each time I observed.
1 I normally set the brightness control knob at a particular brightness which seemed best for the set of conditions under which I was observing. I changed it only when the conditions changed, e.g., moonlight, starlight, terrain, etc.
____ I adjusted the tube brightness according to the range at which I was trying to observe.

9. Which method best describes the manner in which you manipulate the objective focusing ring on the test sight?

2 I adjust the objective focusing ring to correspond with the particular range at which I am attempting to define targets.
____ I adjust the objective focusing ring to a particular setting which I think is best for all ranges. I seldom change it once I am satisfied with the setting.
1 I continuously adjust my objective focusing ring each time I observe an array of targets.

10. Are the controls listed below conveniently located and sensitive to touch?

		Yes	No
a.	Off/on switch	3	___
b.	Reticle brightness	3	___
c.	Diopter scale	2	1
d.	Objective focusing ring	2	1
e.	Tube brightness control	3	___

11. Are the controls listed below sensitive to touch when the operator is wearing gloves?

		Yes	No
a.	Off/on switch	1	2
b.	Reticle brightness	2	1
c.	Diopter scale	3	___
d.	Objective focusing ring	3	___
e.	Tube brightness control	2	1

12. How easy was it to locate the range focusing ring on the test sight in the dark?

2 Very easy
1 Easy
___ Fair
___ Difficult
___ Very difficult

13. Did you experience eye fatigue during any of the observation exercises?

1 Yes
2 No

14. Did you experience lens fogging during the observation exercises?

____ No
3 Yes, I experience lens fogging while using the:

____ Test Sight
____ Control sight
3 Both test and control sight

15. Do you have difficulty identifying any of the controls during darkness?

____ Yes
3 No

16. These questions are applicable only to personnel who wear eyeglasses:

a. Is the test sight compatible with eyeglasses?

1 Yes
____ No

b. Which method describes the manner in which you employ the sight?

1 I wear my glasses
____ I remove my glasses and adjust the diopter setting to suit my eye.

17. The test sight has a wider field of view than does the control sight. Did this capability enable you to detect targets more quickly while using the test sight?

1 Yes
2 No

18. Can you attribute any other advantages to the wider field of view?

____ Yes
3 No

19. Some test sights appeared to be characterized by excessive scintillation (snowy screen).

a. Did this characterize the sights you employed?

1 Yes
2 No

b. Was the scintillation bothersome to the eye?

1 Yes
2 No

c. Did it make the target observation more difficult?

1 Yes
2 No

20. Did you encounter any problems with scintillation while using the control sight?

1 Yes
2 No
___ Don't know

21. Which method best describes the manner in which you employ the night vision sight?

1 I keep one eye closed while observing.
___ I keep both eyes open while observing.
2 I keep both eyes open while scanning for targets. When I think that I have detected something significant, I close one eye.

22. Which sight would you prefer to use?

	Test Scope	Control Scope	No Opinion
a. For long ranges	3	—	—
b. For short ranges	3	—	—
c. For medium ranges	3	—	—
d. For detection	3	—	—
e. For recognition	3	—	—

		Test Scope	Control Scope	No Opinion
f.	For identification	3	—	—
g.	Under starlight conditions	3	—	—
h.	Under moonlight conditions	3	—	—

23. Did the position of the test sight when mounted on the weapon affect the utilization of the weapon and vehicle controls?

— Yes
3 No

24. During the test you have employed the test sight in several types of terrain and under varying light conditions. Based on this experience, do you consider the sight a valuable night vision aid?

3 Yes
— No

25. Is the sight an aid to night vision under all conditions, e.g., brush, open terrain, thickly wooded, moonlight, and starlight conditions?

3 Yes
— No

APPENDIX B. TEST FINDINGS

The following criteria were extracted from the Approved Qualitative Materiel Requirement for Individual and Crew Served Weapons Night Vision Sights (U) (CSCRD-64), 2 Mar 64, (ref 8, app F) except for items 6 and 28 which were formulated by USAARENBD. (All criteria are considered essential unless otherwise indicated.) The underlined portions of the listed requirements were not applicable to this test.

Item	Source	Criteria	Applicable Subtest	Remarks
1	QMR, para 8a(1)	Weight (including integral power source) (Essential): Individual weapon sight - not more than 4 pounds, 2 pounds desirable.		Physical characteristics were determined in the engineering test.
2	QMR, para 8b(1)	Size will be as small as possible consistent with other characteristics, but must not exceed lengths given below and must not degrade man portability and performance characteristics of weapons with which the sight is to be employed. Individual weapon sight - not more than 11 inches long.	2.6	Met. See results in para 2.6.4.4 and analysis in para 2.6.5.3.
3	QMR, para 8c	A mounting bracket will be developed for each of the weapons listed in Annex A, taking into account the method of employment and the muzzle velocity. (See note (*) at the end of Annex A for weapons requiring special attention. Mounting brackets will permit quick, simple attachment of the sight to the weapon in darkness. The brackets must allow repeated mounting and dismounting of sights without significant change in zero.	2.4	Met. See results in para 2.4.4.1 and 2.4.4.4 and analysis in para 2.4.5.1.

Item	Source	Criteria	Applicable Subtest	Remarks
		Bore sighting may be required when weapons and sights are intermixed.		
4	QMR, para 8i	Power source will consist of standard expendable batteries. Minimum battery life will be such that the sight can be operated continuously for at least 12 hours without replacement. Desire that the crew-served weapons sight be capable of operating from vehicular power systems providing there is no weight penalty associated with providing this capability. A cold weather kit consistin of a pack with battery to be worn on the body for warmth and with lead wire and connector is permissible.	2.8	Met. See results in para 2.8.4.6 and analysis in para 2.8.5.9.
5	QMR, para 10c	Suitable methods will be developed for carrying the sight when it is not attached to the weapon. The sight case will be provided with straps or clips so that it can be carried on a fully equipped combat soldier's web equipment or over his shoulder. This will be done with minimum adverse effect to the load-carrying capacity, mobility, and feeedom of operation of the individual soldier.	2.2	Met. See summation in para 2.2.
6	USAARENBD	The test item shall be safe to operate and maintain.	2.3	Met. See results in para 2.3.4.1 and analysis in para 2.3.5.1

Item	Source	Criteria	Applicable Subtest	Remarks
7	QMR, para 8m	Design will make provision for indication of clicks both audibly and in a manner sensitive to touch to facilitate zeroing. Zeroing procedures will be essentially the same as for standard daylight sights.	2.4	Met. See results in para 2.4.4.6 and analysis in para 2.4.5.2.
8	QMR, para 7a(1)	Range: Individual Weapons Sight - Recognize a standing man from 25 to at least 400 meters in clear air in starlight and 25 to at least 600 meters in clear air in moonlight.	2.5	Met. See summation in para 2.5.
9	QMR, para 7d	(Desirable) During ambient light conditions less than starlight, these sights will be usable in conjunction with invisible light sources to increase range. Otherwise sights will be completely passive. The sights will also have a capability of detecting enemy use of near infrared emitters.	2.5	Met. See summation in para 2.5.
10	QMR, para 7e	Capability to see through enemy camouflage is desirable.	2.5	Not met. See summation in para 2.5.
11	QMR, para 1b	The sights will permit a hit probability equal to that obtained with the given weapon in daylight.	2.6	Not met. See results in para 2.6.4.2 and analysis in para 2.6.5.2.
12	QMR, para 8g	Flash and glare protection for operator and the sights is essential. This includes protection against exposure to daylight.	2.3	Met. See results in para 2.3.4.2 and analysis in para 2.3.5.2.

Item	Source	Criteria	Applicable Subtest	Remarks
13	QMR, para 8o	Sights must be moistureproof and dustproof.	2.8	Not met. Dust particles entered one sight. See results in para 2.8.4.7 and analysis in para 2.8.5.10.
14	QMR, para 8e	The sight will be of a configuration such that it will not catch on clothing, brush, low-hanging trees, and the like.		Not a USAARENBD requirement.
15	QMR, para 8l	Reticles will be designed so the sight picture for each weapon listed in Annex A is as close as possible tc the sight picture obtained with applicable daylight sight. The reticle shall not obscure the target by side flow effects. (Desirable) That the reticle impose minimum drain on the power supply. A minimum number of reticle patterns is desired consistent with ballistic characteristics of the various weapons involved. See note (*) at the end of Annex A for weapons requiring special attention.	2.6	Met. See results in para 2.6.4.1 and analysis in para 2.6.5.1.
16	QMR, para 7g	Sights must be capable of use with gas masks M14 and M17 and their future replacements.	2.5	Met. See summation in para 2.5.
17	QMR, para 8f	The eyepiece and lens will be protected against fogging either from moisture generated by body heat or by humid conditions.	2.5	Met. See summation in para 2.5.

Item	Source	Criteria	Applicable Subtest	Remarks
18	QMR, para 19	Communications Security (COMSEC) Operation of the weapon sight will not interfere with communications, surveillance or other COMMEL equipment or vice versa.	2.7	Met. See summation in para 2.7.
19	QMR, para 16	Cover and deception. Item will be completely passive and no more detectable at night (with reasonable precautions as far as the eyepiece is concerned) than is the operator and his weapon without the sight.	2.7	Met. See summation in para 2.7.
20	QMR, para 8d	Durability: Sight must withstand rough handling associated with transportation and use during combat operations.	2.8	Not met. See results in para 2.8.4.2 and 2.8.4.3; analysis in para 2.8.5.1 and 2.8.5.5; and deficiency in para 1.2, app C.
21	QMR, para 8j	Sight must withstand the shock of repeated firings without damage or change of adjustment.	2.8	Met. See results in para 2.8.4.4 and analysis in para 2.8.5.2.
22	QMR, para 8d	Normal combat life of this item (Mean Time Between Failure not including operator maintenance requirements) will be 1,000 operating hours, 2,000 operating hours (desirable).	2.8	Not assessed. See results in para 2.8.4.3 and analysis in para 2.8.5.3.
23	QMR, para 8d	Sensor life will be at least 1,000 hours, 2,000 hours (desirable).	2.8	Not assessed. See results in para 2.8.4.5 and analysis in para 2.8.5.4.

Item	Source	Criteria	Applicable Subtest	Remarks
24	QMR, para 7i	The sight will have a 90% probability of performance without failure for 1,000 operating hours under the basic operating conditions of paragraph 7a, AR 705-15.		Not compatible with item 22.
25	QMR, para 10a	The equipment will be designed in accordance with good human factors engineering practice. The equipment will be considered as a component of a man-machine system and will be developed with full consideration for the intellectual, physical, and psychomotor capabilities of the intended user and maintenance personnel. Arrangement, size, and shape of operator control will permit ready tactile identification and adjustment in darkness. The equipment will be operable by personnel wearing arctic clothing and protective masks. Appropriate manuals detailing operating and maintenance procedures will be provided.	2.10	Met. See results in para 2.10.4.1 and 2.10.4.3 and analysis in para 2.10.5.1.
26	QMR, para 10b	The weight and balance of the sight will be such as to minimize operator fatigue and not adversely affect the balance and other firing characteristics of the weapon.	2.10	Met. See results in para 2.10.4.2 and analysis in para 2.10.5.2.
27	QMR, para 8n	Access to knobs or switches will be convenient from any of the normal firing positions. Adjustment will be practicable for an operator wearing gloves. Use of an adapter kit when the operator is wearing arctic mittens (3 finger type FSC 844-160-1376) is applicable.	2.10	Not met. Difficulty was encountered making adjustments while wearing gloves. See results in para 2.10.4.1 and 2.10.4.4 and analysis in para 2.10.5.3.

Item	Source	Criteria	Applicable Subtest	Remarks
28	USAARENBD	The test and control sights will be complete and serviceable.	2.1	Met. See summation in para 2.1.

APPENDIX C. DEFICIENCIES, SHORTCOMINGS, CORRECTED DEFICIENCIES AND SHORTCOMINGS, AND SUGGESTED IMPROVEMENT

1. DEFICIENCIES

	Deficiency	Suggested Corrective Action	Remarks
1.1	The test item loses its adjusted zero after cross-country travel.		See results in para 2.4.4.3 and analysis in para 2.4.5.3.
1.2	The rubber eye guard separates from the eyepiece. This prevents the weapon-sight system from being fired effectively, and tube brightness illuminates the gunner's face.	Provide a stronger bonding method between the eye guard body and the eye guard retaining nut.	See EPR No KD-12; results in para 2.8.4.3; and analysis in para 2.8.5.1 and 2.8.5.5.
1.3	The maintenance test package is inadequate (equipment publications and personnel MOS requirements).		See EPR No KD-1(Pub), KD-1-S1 (Pub), KD-1-S2(Pub), KD-2 (Pub), KD-2-S1(Pub), KD-2-S2(Pub), KD-3(Pub), and KD-4(Pub); results in para 2.9.4.4; and analysis in para 2.9.5.
1.3.1	The -12, -34, and -34P manuals contain incorrect, incomplete, or unclear instructions, and are not in conformance with pertinent DA regulations.	Revise the manuals in accordance with DA Forms 2028.	
1.3.2	The proper MOS to perform organizational maintenance is not designated.	Designate the proper personnel to perform organizational maintenance. MOS to be considered is 31B.	

2. SHORTCOMINGS

	Shortcoming	Suggested Corrective Action	Remarks
2.1	During high illumination, the sight reticle is not sufficiently visible, and the sight cannot be aligned/ zeroed during daylight.	Make the holes in the day-light cover smaller.	See results in para 2.4.4.7 and analysis in para 2.4.5.4.
2.2	The procedures in the draft -12 manual for zeroing the test item at close ranges are incomplete. Location of round impact at 25 meters for the M60 machinegun is not specified. Incomplete zero-ing procedures adversely affects accuracy of the weapon.	Provide complete instructions.	See EPR No KD-11; results in para 2.4.4.1; and analysis in para 2.4.5.5.
2.3	The design of the locking knob for the mounting bracket is such that it cannot be se-cured to the bracket, thus, it falls out of the bracket.	Provide a locking device for the locking knob.	See analysis is para 2.8.5.7.

3. CORRECTED DEFICIENCIES AND SHORTCOMINGS

	Deficiency/Shortcoming	Corrective Action	Remarks
3.1	The retaining ridge on the demist lens was too large and the lens could not be inserted into the eyepiece. (This was noted in the test-ing conducted to 8 Jan 73.)	One modification applied when testing was suspended was to remove the demist lens. This has eliminated the problem.	See EPR No KD-6 and KD-6-S1 and summation in para 2.1.

	Deficiency/Shortcoming	Corrective Action	Remarks
3.2	The setscrews in the rear retaining ring loosened and allowed the rear retaining ring to separate from the range focus ring. (This was noted in testing conducted to 8 Jan 73.)	A new focus ring, and a change in the slipring and setscrew material were part of the modifications applied to the sight. This has corrected the problem.	See EPR No KD-7, KD-7-S1, KD-8 and KD-8-S1 and analysis in para 2.8.5.8.
3.3	The threads on the plastic reticle cell housing lack sufficient durability to withstand the stress of turning pressure, and as a result, the housing fails. (This was noted in the testing conducted to 8 Jan 73.)	Reticle cells were modified to use a different material. This has corrected the problem.	See EPR No KD-5 and KD-5-S1 and analysis in para 2.8.5.8.
3.4	The gauge, thickness set is too long for the working space in the objective housing. . . . (This was noted in the testing to 8 Jan 73.)	Requirement for the gauge was eliminated by modification of the sight.	See EPR KD-4 and results in para 2.9.4.3.
3.5	The image intensifier tube malfunctions causing loss of sight picture.	Different tube manufacture and increased cone and decelerator spot welds. (See para 1.2.2.4.)	See analysis in para 2.8.5.6.

4. SUGGESTED IMPROVEMENT

Suggestion	Remarks
The operator's manual should note that intermixing weapons and sights might require additional zeroing procedures.	See results in para 2.4.4.5 and analysis in para 2.4.5.1.

NOTE: The EPR listed in para 3 above are reclassified as indicated. All other EPR were originally submitted, or have been reevaluated, and are hereby reclassified "FOR INFORMATION ONLY".

APPENDIX D. MINTENANCE EVALUATION

TABLE OF CONTENTS

PART 1-A

MAINTENANCE ANALYSIS CHART INSTRUCTION SHEET

COLUMN	DESCRIPTION
1	Group number as indicated in the Maintenance Allocation Chart or TB 750-93-1 of Assembly or Subassembly when the MAC is not available. The sequence in which the actual maintenance operation was performed is indicated in parentheses.
2	Component and related operations as indicated in the Maintenance Allocation Chart. When the component is taken from TB 7 50-93-1, the related operations are stated from previous testing experiences. Operations indicated as in Depot Category are not shown.
3	Maintenance Level, Prescribed. Category prescribed by the Maintenance Allocation Chart is indicated by the letters C, O, F, H. C-Operator/Crew; O-Organizational; F-Direct Support; H-General Support. "NP" indicates not prescribed.
4	Maintenance Level, Recommended. Category recommended by the test agency.
5&6	TM Instructions. An "X" in these columns indicate the TM instructions are considered adequate or inadequate.
7	Active Maintenance Time. The man-hours and clock-hours of active maintenance time to the nearest tenth are shown. The symbol "NC" indicates nonchargeable maintenance time. The symbol "E" indicates an estimated active maintenance time.
8	System Life. Number of "Hours" accumulated before this operation was performed. The sequence number for which the particular operation was last performed is shown in parentheses.
9	Reason Performed. The symbol "UNS" is shown in this column if the operation was performed as a result of unscheduled maintenance. If the operation was performed as a result of scheduled maintenance, it is indicated by the sumbol "SCH".
10	Remarks. If an EPR was related to a maintenance operation, the EPR KD Number is indicated. The notation "Failure" indicates operations performed as a result of a failure.

PART IB. DATA

MAINTENANCE ANALYSIS CHART (USAARENBD MEMO 750-15)	PROJECT NO 7-ES-315-SLS-002	NOMENCLATURE Night Vision Sight, Individual Served Weapons	IDENTIFICATION 95-112

GP NO (SEQ NO)	COMPONENT AND RELATED OPERATIONS	MAINT LEVEL C-OPR/CREW O-ORG F-DIRECT H-GENERAL		TM INSTRUCTIONS		ACTIVE MAINTENANCE TIME		SYSTEM LIFE HOURS	REASON PERFORMED	REMARKS
		PRESB	RECOM	ADQT	INADQT	CLOCK HOURS	MAN HOURS			
1	2	3	4	5	6	7		8	9	10
(1)	Performed: Initial Technical Inspection	O	O	X		1.5 NC	1.5 NC	0.0	SCH	
(2)	Performed: Monthly Service	O	O		X	1.0	1.0	563.25	SCH	EPR KD-1-S2(Pub)
1C1 (3)	Repaired: Eye Guard	F	F	X		0.6	0.6	602.0	UNS	Failure. EPR KD-12
(4)	Replaced: Batteries (15) Sets	C	C	X		0.2E	0.2E	1,060.75	UNS	All batteries replaced are included in this entry. (See sequence 5, Parts Analysis Charts, in part 2-B, this appendix.)
(5)	Performed: Final Technical Inspection	O	O		X	1.5 NC	1.5 NC	1,060.75	SCH	EPR KD-1-S2(Pub)

D13

EBB FORM 1014 25 Nov 70 (Rev) Replaces EBB FORM 1014 31 Mar 70 which will not be used.

MAINTENANCE ANALYSIS CHART (USAARENBD MEMO 750-15)	PROJECT NO 7-ES-315-SLS-002	NOMENCLATURE Night Vision Sight, Individual Served Weapons	IDENTIFICATION 95-113

GP NO (SEQ NO)	COMPONENT AND RELATED OPERATIONS	MAINT LEVEL C-OPR/CREW O-ORG F-DIRECT H-GENERAL		TM INSTRUCTIONS		ACTIVE MAINTENANCE TIME		SYSTEM LIFE HOURS	REASON PERFORMED	REMARKS
		PRESB	RECOM	ADQT	INADQT	CLOCK HOURS	MAN HOURS			
1	2	3	4	5	6	7		8	9	10
(1)	Performed: Initial Technical Inspection	O	O	X		1.5 NC	1.5 NC	0.0	SCH	
(2)	Performed: Monthly Service	O	O		X	1.0	1.0	586.75	SCH	EPR KD-1-S2(Pub)
(3)	Serviced: Sight Assembly	F	F	X		0.8	0.8	678.75	UNS	EPR KD-13. Disassembled and cleaned.
(4)	Replaced: Batteries (14) Sets	C	C	X		0.2E	0.2E	1011.75	UNS	All batteries replaced are included in this entry. (See sequence 5, Parts Analysis Charts, in part 2-B, this appendix.)
(5)	Performed: Final Technical Inspection	O	O		X	1.5	1.5	1011.75	SCH	EPR KD-1-S2(Pub)

EBB FORM 1014 25 Nov 70 (Rev) Replaces EBB FORM 1014 31 Mar 70 which will not be used.

PART 2-A

PARTS ANALYSIS CHART INSTRUCTION SHEET

GENERAL: Parts are listed on charts by functional group and in numerical order within groups.

COLUMN	DESCRIPTION
1	Sequence Number, Group Number, Parts usage by maintenance operation is indicated by a cross-reference to the sequence number and group number from column 1 of the Maintenance Allocation Chart.
2	Federal Stock Number, Technical Service Part Number, Manufacturer's Part Number, or Drawing Number, The number of parts used is shown in parentheses.
3	Noun Nomenclature. As listed in the parts manual.
4	Maintenance Level, Prescribed. Maintenance level as prescribed by the parts list under review; C-Operator/Crew; O-Organizational; F-Direct Support; H-General Support. "N" indicates not prescribed.
5	Maintenance Level, Recommended. The code symbols, C, O, F, or H, indicate maintenance level recommended by the test agency.
6	Part Life. The number of hours accumulated by this part.
7	Reason Used. The symbol "UNS" is shown in this column if the part used was a result of unscheduled maintenance. The symbol "SCH" indicates the part was replaced as a result of a scheduled maintenance action. "NC" in this column indicates the part was replaced because of nonchargeable maintenance.
8	Remarks. The EPR KD Number is shown in this column if the part used was replaced as a result of a failure.

PART 2-R, DATA

PARTS ANALYSIS CHART	PROJECT NO. 7-ES-315-SLS-002	NOMENCLATURE Night Vision Sight, Individual Served Weapons					IDENTIFICATION NO. 95-112
(SEQUENCE NO) GP NO.	FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL C - OPERATOR/CREW O - ORG F - DIRECT H - GENERAL PRESB	MAINTENANCE LEVEL C - OPERATOR/CREW O - ORG F - DIRECT H - GENERAL RECM	PART LIFE (Hours)	REASON USED	REMARKS
1	2	3	4	5	6	7	8
(5)* 1A1	6135-485-7402 (2 ea)	Battery Dry	C	C	72.0	UNS	*Sequence No 5 used in part 1-B as one entry for all batteries replaced during the test.
	6135-485-7402 (2 ea)	Battery Dry	C	C	72.0	UNS	
	6135-485-7402 (2 ea)	Battery Dry	C	C	72.0	UNS	
	6135-485-7402 (2 ea)	Battery Dry	C	C	48.0	UNS	
	6135-485-7402 (2 ea)	Battery Dry	C	C	31.25	UNS	
	6135-485-7402 (2 ea)	Battery Dry	C	C	74.0	UNS	
	6135-485-7402 (2 ea)	Battery Dry	C	C	74.5	UNS	
	6135-485-7402 (2 ea)	Battery Dry	C	C	94.0	UNS	
	6135-485-7402 (2 ea)	Battery Dry	C	C	97.5	UNS	
	6135-485-7402 (2 ea)	Battery Dry	C	C	68.5	UNS	
	6135-485-7402 (2 ea)	Battery Dry	C	C	71.0	UNS	

PARTS ANALYSIS CHART	PROJECT NO. 7-ES-315-SLS-002	NOMENCLATURE Night Vision Sight, Individual Served Weapons				IDENTIFICATION NO. 95-112
(SEQUENCE NO) GP NO.	FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL C - OPERATOR/CREW O - ORG F - DIRECT H - GENERAL		PART LIFE (Hours)	REASON USED	REMARKS
			PRESB	REMM			
1	2	3	4	5	6	7	8
	6135-485-7402 (2 ea)	Battery Dry	C	C	79.25	UNS	
	6135-485-7402 (2 ea)	Battery Dry	C	C	88.75	UNS	
	6135-485-7402 (2 ea)	Battery Dry	C	C	94.0	UNS	
	6135-485-7402 (2 ea)	Battery Dry	C	C	24.0	UNS	

PARTS ANALYSIS CHART	PROJECT NO. 7-ES-315-SLS-002	NOMENCLATURE Night Vision Sight, Individual Served Weapons				IDENTIFICATION NO. 95-113
(SEQUENCE NO) GP NO.	FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL C - OPERATOR/CREW O - ORG F - DIRECT H - GENERAL PRESB	RECM	PART LIFE (Hours)	REASON USED	REMARKS
1	2	3	4	5	6	7	8
(5)* 1A1	6135-485-7402 (2 ea)	Battery Dry	C	C	72.0	UNS	*Sequence No 5 used in part 1-B as one entry for all batteries replaced during the test.
	6135-485-7402 (2 ea)	Battery Dry	C	C	72.0	UNS	
	6135-485-7402 (2 ea)	Battery Dry	C	C	72.0	UNS	
	6135-485-7402 (2 ea)	Battery Dry	C	C	72.0	UNS	
	6135-485-7402 (2 ea)	Battery Dry	C	C	81.25	UNS	
	6135-485-7402 (2 ea)	Battery Dry	C	C	98.50	UNS	
	6135-485-7402 (2 ea)	Battery Dry	C	C	46.0	UNS	
	6135-485-7402 (2 ea)	Battery Dry	C	C	48.0	UNS	
	6135-485-7402 (2 ea)	Battery Dry	C	C	97.0	UNS	
	6135-485-7402 (2 ea)	Battery Dry	C	C	67.0	UNS	
	6135-485-7402 (2 ea)	Battery Dry	C	C	70.0	UNS	

PARTS ANALYSIS CHART	PROJECT NO. 7-ES-315-SLS-002	NOMENCLATURE Night Vision Sight, Individual Served Weapons				IDENTIFICATION NO. 95-113
(SEQUENCE NO) GP NO.	FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL C - OPERATOR/CREW O - ORG F - DIRECT H - GENERAL PRESB	RECM	PART LIFE (Hours)	REASON USED	REMARKS
1	2	3	4	5	6	7	8
	6135-485-7402 (2 ea)	Battery Dry	C	C	96.0	UNS	
	6135-485-7402 (2 ea)	Battery Dry	C	C	96.0	UNS	
	6135-485-7402 (2 ea)	Battery Dry	C	C	24.0	UNS	

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PART 3-A

MAINTENANCE PACKAGE LITERATURE CHART INSTRUCTION SHEET

COLUMN	DESCRIPTION
1	Army or manufacturer's publication or draft manual number
2	Number of copies received
3	Complete title
4	Date publication was received
5	Date test item or material was received
6&7	An "X" in appropriate column shows results of evaluation
8	EPR KD (Pub) Number and date DA Form 2028 was forwarded
9	Appropriate remarks

PART 3B. DATA

MAINTENANCE PACKAGE LITERATURE CHART	PROJECT NO. 7-ES-315-SLS-C02	NOMENCLATURE Night Vision Sight, Individual Served Weapons	IDENTIFICATION NO. 95-112, 95-113

MANUSCRIPT			DATE RECEIVED		EVALUATION		FORM 1598	
NUMBER	QTY	TITLE	LIT	MATERIEL	ADQT	INADQT	DATE FORWARDED	REMARKS
1	2	3	4	5	6	7	8	9
DTM 11-5855-213-12	2	Operator and Organizational Maintenance Manual for Night Vision Sight, Individual Served Weapons AN/PVS-4( ) (V) Mar 1974	7 Mar 74	5 Apr 74		X	KD-1(Pub), 7 Nov 72 KD-1-S1(Pub), 9Jan73 KD-1-S2(Pub), 6Aug74	See results in para 2.9.4.4 and analysis in para 2.9.5.2.
DTM 11-5855-213-34	2	Direct and General Support Maintenance Manual for Night Vision Sight, Individual Served Weapons AN/PVS-4( ) (V) Mar 1974	7 Mar 74	5 Apr 74		X	KD-2(Pub), 10 Nov 72 KD-2-S1(Pub), 8 Jan 73 KD-2-S2(Pub), 5 Aug 74	See results in para 2.9.4.4 and analysis in para 2.9.5.2.
DTM 11-5855-213-20P	2	Repair Parts and Special Tools List for Organizational Maintenance for Night Vision Sight, Individual Served Weapons AN/PVS-4( ) (V) Oct 1973	7 Mar 74	5 Apr 74	X		KD-3(Pub), 5 Aug 74	See results in para 2.9.4.4b and analysis in para 2.9.5.2.
DTM 11-5855-213-34P	2	Repair Parts and Special Tools List for Direct Support and General Support Maintenance (Including Depot Overhaul Parts) for Night Vision Sight, Individual Served Weapons AN/PVS-4( ) (V) Jan 1974	7 Mar 74	5 Apr 74		X	KD-4 (Pub), 6 Aug 74	See results in para 2.9.4.4 and analysis in para 2.9.5.2.

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PART 4-A

SPECIAL TOOLS AND TEST EQUIPMENT CHART INSTRUCTION SHEET

COLUMN	DESCRIPTION
1	Nomenclature or Description. Nomenclature as shown in the manual. Noun nomenclature and brief description of item is shown when tool or test equipment is not listed in the manual.
2	Federal Stock Number or Part Number. Federal Stock Number, Part Number or Drawing Number.
3	Maintenance Level, Prescribed. Maintenance level authorized the tool as prescribed by the technical publication.
4	Maintenance Level, Recommended. Maintenance level recommended by test agency.
5	Date Received. Date the tool or test equipment was received by the test agency.
6	Evaluation, Adequate. An "X" in this column indicates the tool was found to be adequate for its intended purpose at the maintenance level recommended in column 4.
7	Evaluation, Inadequate. An "X" in this column indicates the tool was found to be inadequate for its intended use.
8	Required (RQR), "Yes" or "No". A "Yes" in this column indicates the tool or test equipment is required at the maintenance level indicated in column 4. A "No" in this column indicates the tool or test equipment is not required.
9	Technical Manual in Which Listed. The "Number" of the technical publication for the test item in which the tool or test equipment is listed.
10	Remarks. Self-explanatory.

PART 4B. DATA

SPECIAL TOOL AND TEST EQUIPMENT CHART	PROJECT NO 7-ES-315-SLS-002			NOMENCLATURE Night Vision Sight, Individual Served Weapons					
NOMENCLATURE OR DESCRIPTION	FSN OR PART NO	MAINT LEVEL C - OP/CREW O - ORG F - DIRECT H - GENERAL		DATE RECEIVED	EVALUATION		RQR YES OR NO	TECHNICAL MANUAL IN WHICH LISTED	REMARKS
		PRESB	RECM		ADQT	INADQT			
1	2	3	4	5	6	7	8	9	10
*Multimeter TS-352	6625-242-5023	F	F	15 Feb 74	X		No	None	*Indicates tools furnished as special tools in MTP, but are common in the Army inventory. (#2 Common Tool Set)
*Tool Kit TK 105/G	5180-610-8177	F	F	15 Feb 74	X		No	None	*Indicates tools furnished as special tools in MTP, but are common in the Army inventory. (#2 Common Tool Set)
*Tool Kit TK 101	5210-221-2031	F	F	15 Feb74	X		No	None	*Indicates tools furnished as special tools in MTP, but are common in the Army inventory. (#2 Common Tool Set)
Allen Wrench, Modified .050	Unknown	F	F	15 Feb74	X		Yes	DTM 11-5855-213-34P	

EBB FORM 1010, 1 Jul 67

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PART 5-A

REPAIR PARTS USAGE DATA INSTRUCTION SHEET

COLUMN	DESCRIPTION
1	FSN/Part No. Federal Stock Number, Technical Service Part Number, or Manufacturer's Part Number.
2	Noun Nomenclature. As listed in the parts manual.
3	Quantity received in Maintenance Test Package. Quantity initially received by the test agency in the Maintenance Test Package which was provided prior or concurrently with the test item(s) to support testing. Additional repair parts received during conduct of the test are not listed in this column.
4	Quantity Used During Test. Quantity used on the test item(s) throughout the test period. This quantity may be more than quantity listed in column 3 and would indicate additional repair required over and above those received in the test package. Quantities in this column agree with the data recorded on the Parts Analysis Charts.

PART 5-B . REPAIR PARTS USAGE DATA (AEBM 750-15)

PROJECT NO	NOMENCLATURE
7-ES-315-SLS-002	Night Vision Sight, Individual Served Weapons, AN/PVS-4

FSN/PART NO	NOUN NOMENCLATURE	QUANTITY REC IN MAINT TEST PACKAGE	QUANTITY USED DURING TEST
1	2	3	4
501-2690-401	Eye Guard Assy	1	
510-2745-301	Battery Retainer w spring	1	
501-2604	Main Housing	1	
EC 801-MIL-S-7502	Sealing Compound	1	
DC 33-MIL-G-8660	Silicone Compound	1	
(RTU 103)MIL-A-46106	Rubber Adhesive	1	
501-2999-301	Mount Adapter	1	
6850-200-2397	Antifogging Compound	1	
MIL-S-22473	Locktite (Grade B)	1	
NAS1352-3-20P	Screw, Mach (Adapter Mount)	2	
MS 51957-11	Setscrew	2	
LCI-050-10	Block, Tube Stop	2	
501-2767-302	Protective Cap (Reticle)	1	
305-023-(83003)	Illuminator Assy	1	
501-2786-301	Wire, Electrical (Red)	6	
501-2786-302	Wire, Electrical (Blue)	6	
501-2786-303	Wire, Electrical (Yellow)	6	
501-2786-304	Wire, Electrical (Black)	6	
MS 51959-27	Screw, Mach	6	
MS 9021-021	Packing, Preformed (Battery)	2	
MS 9021-132	Packing, Preformed (Housing)	2	
MS 35338-134	Washer Lock Spring	12	
MS 9021-022	Packing, Preformed (Protective Cap)	2	

EBB Form 1021
1 Apr 74

Edition of 1 Sep 73 is obsolete

PART 5-B . REPAIR PARTS USAGE DATA (AEBM 750-15)

PROJECT NO	NOMENCLATURE
7-ES-315-SLS-002	Night Vision Sight, Individual Served Weapons, AN/PVS-4

FSN/PART NO	NOUN NOMENCLATURE	QUANTITY REC IN MAINT TEST PACKAGE	QUANTITY USED DURING TEST
1	2	3	4
HS 51957-1	Screw, Mach (Pan Head)	4	
328-0023-015	Resistor, Variable, IK	1	
328-0023-013	Resistor, Variable, 50 K	1	
501-2710-301	Switch, Knob Assy (Reticle)	1	
HS 9021-040	Packing, Preformed (Eyepiece)	2	
MS 51957-1	Screw, Mach (Pan Head)	12	
6135-485-7402	Battery, Dry	300	58

EBB Form 1021
1 Apr 74

Edition of 1 Sep 73 is obsolete

APPENDIX E. CRITICAL ISSUES

Not used.

APPENDIX F. REFERENCES

1. Msg, AMSTE-GE, HQ TECOM, 052100Z Jan 73, subject: Engineering and Service Test of Night Vision Sight, Individual Served Weapons, AN/PVS-4, TECOM Project Nos 7-ES-315-SLS-001/002 and Night Vision Sight, Crew Served Weapons, AN/TVS-5, TECOM Project Nos 7-ES-315-CSW-001/002.

2. USAARENBD Partial Report of Service Test of Night Vision Sight, Individual Served Weapons, AN/PVS-4, TECOM Project No 7-ES-315-SLS-002, 21 Feb 73.

3. Ltr, STEBB-TD-A, USAARENBD, 8 Jul 74, subject: Interim Report of Development Test II (Service Phase) of Night Vision Sight, Individual Served Weapons, AN/PVS-4, TECOM Project No 7-ES-315-SLS-002, w 3 incl.

4. Ltr, AMSTE-GE, HQ USATECOM, 20 May 70, subject: Test Directive, Engineering and Service Test of Night Vision Sight, Small Starlight Scope (Second Generation), USATECOM Project Nos 7-ES-315-SLS-001/002/003/004/005 (U), w 7 incl.

5. Ltr, AMSTE-GE, HQ TECOM, 1 Jun 72, subject: Amendment 1 to Test Directive, Engineering and Expanded Service Test of Night Vision Sight, Small Starlight Scope (Second Generation), TECOM Project Nos 7-ES-315-SLS-001/002/003/004/005, w 1 incl.

6. USAIB Plan for Service Test of Night Vision Sight, Small Starlight Scope (Second Generation), TECOM Project No 7-ES-315-SLS-002, Sep 70, w C1, 22 Mar 72 and C2, undated.

7. USAARENBD Third Partial and Final Report of Development Test II (Service Phase) of Night Vision Sight, Crew Served Weapons (Second Generation), TECOM Project No 7-ES-315-CSW-002, 26 Aug 74.

8. Approved Qualitative Materiel Requirement for Individual and Crew Served Weapons Night Vision Sights (CSCRD-64), USACDC, 2 Mar 64.

APPENDIX G. ABBREVIATIONS

CH - Clock-Hours

C&R - Command and Reconnaissance

ea - Each

MAV - Minimum Acceptable Value

MH - Man-Hours

MM - Millimeter

MTP - Maintenance Test Package

NVL - Night Vision Laboratory

APPENDIX H. DISTRIBUTION LIST

TECOM PROJECT NO 7-ES-315-SLS-002

Addressee	Test Plan	EPR	Interim Report	Final Report
Commander US Army Test and Evaluation Command ATTN: AMSTE-GE AMSTE-SG-H Aberdeen Proving Ground, MD 21005	1	1	9	9 1
Commander US Army Materiel Command ATTN: AMCRD-O AMCRD-R AMCRD-U AMCMA AMCQA AMCSF 5001 Eisenhower Avenue Alexandria, VA 22333				3 1 1 1 1 1
Commander US Army Training and Doctrine Command ATTN: TRADOC LO, TECOM Aberdeen Proving Ground, MD 21005				10
Commander HQ MASSTER ATTN: ATMAS-OP Fort Hood, TX 76544				1
Commander US Army Electronics Command ATTN: AMSEL-RD-GTT Fort Monmouth, NJ 07703		1		5
Commander US Army Logistics Evaluation Agency ATTN: LEA-IL New Cumberland Army Depot New Cumberland, PA 17070		1		1
Commander Institute of Special Studies ATTN: CDCISS-NV Fort Belvoir, VA 22060		2		

Addressee	Test Plan	EPR	Interim Report	Final Report
Commander Defense Documentation Center for Scientific and Technical Information ATTN: Document Service Center Cameron Station Alexandria, VA 22314				2
Director Night Vision Laboratory ATTN: AMSEL-NV-SE Fort Belvoir, VA 22060		3		5
Commandant US Army Infantry School ATTN: ATSIN-I Fort Benning, GA 31905		1		3
Commandant US Army Armor School ATTN: ATSB-CD-OT ATZK-CG-SA Fort Knox, KY 40121		1 1		5 1
Commander US Army Maintenance Management Center ATTN: AMXMD-IDV Lexington, KY 40507		2		1
HQDA (DAMO-FD) (DAMA-PPM-T) (DALO-SMM-E) (DALO) WASH DC 20310				1 2 1 1
US Marine Corps Liaison Officer US Army Test and Evaluation Command Aberdeen Proving Ground, MD 21005				1
Marine Corps Liaison Officer US Army Armor and Engineer Board Fort Knox, KY 40121				2
Commander Aberdeen Proving Ground ATTN: STEAP-MT STEAP-TL Aberdeen Proving Ground, MD 21005		1		1 1

Addressee	Test Plan	EPR	Interim Report	Final Report
Commander Yuma Proving Ground ATTN: STEYP-TPC Yuma, AZ 85364		1		1
Commander US Army Tropic Test Center ATTN: STETC-TS-OP APO New York 09827		1		1
Commander US Army Arctic Test Center ATTN: STEAC-OP APO Seattle 98733		1		1
President US Army Armor and Engineer Board ATTN: STEBB-TD-A Fort Knox, KY 40121	12	7	10	9
President US Army Infantry Board ATTN: STEBC-OP Fort Benning, GA 31905	2	1		1
President US Army Airborne, Communications and Electronics Board ATTN: STEBF-OP Fort Bragg, NC 28307		1		1
Director US Army Materiel Systems Analysis Agency ATTN: AMXSY-RE AMXSY-DA Aberdeen Proving Ground, MD 21005		1		1
Commander US Army Training and Doctrine Command ATTN: ATCD-C Fort Monroe, VA 23651		1		
Commander US Army Logistics Center ATTN: ATCL-A Fort Lee, VA 23801		1		